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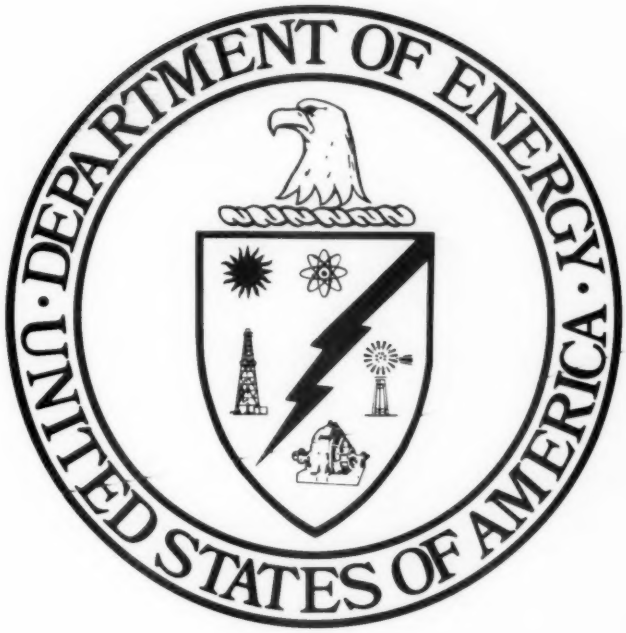

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CORRECTIONS

ERA Vol. 1, No. 3, Abst. 3607, line 1 should read: (ORO-4183-23) Chemical effects of ionizing radiations

ERA Vol. 1, No. 4, Abst. 5714, line 4 should read: German and English). TIC

ERA Vol. 1, No. 5, Abst. 6724, line 6 should read: 23p. (ENDF-224). Dep. NTIS, PC A02/MF A01.

ERA, Vol. 1, No. 11, Abst. 24981, line 1 should read: (ORO-2972-1(Task C) Experimental measurements at

ERA Vol. 2, No. 20, Abst. 48310, line 1 should read: (BNWL-SA-5997) Ammonia as an intermediate heat ex-

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(BAW—10074A(Rev.1))
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Ackermann, A., Excitation functions of the (n,2n) reactions of ^{12}C and ^{238}U, 1:18034
Ackley, M.H., *See* Derr, V.E., 1:17257
Acton, J.P., *See* Mitchell, B.M., 1:16369
Adam, J.C., *See* Gitomer, S.J., 1:18301
Adams, A.A., *See* Barger, H.J. Jr., 1:16409
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DIETHYLENETRIAMINEPENTAACETIC ACID
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DIFFERENTIAL EQUATIONS
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DIFFERENTIAL EQUATIONS/ANALYTICAL SOLUTION
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Volume 3, Number 14, July 31, 1978

ENERGY RESEARCH ABSTRACTS

COAL AND COAL PRODUCTS

PROCESSING

32536 (NTIS/PS—77/0884) **Coal beneficiation (citations from the NTIS data base). Report for 1964—Sep 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 125p. NTIS PC N01/MF N01.

Abstracts of Federally-funded research dealing primarily with separation of pyrite from coal and washability studies are presented. Washing equipment, coal cleaning plants and grinding, flotation, and chemical cleaning methods are included. A few abstracts pertain to environmental considerations, concerning coal preparation wastes. (This updated bibliography contains 120 abstracts, 41 of which are new entries to the previous edition.)

32537 (NTIS/PS—77/0885) **Coal beneficiation. Volume 1. 1970-1975 (citations from the Engineering Index data base). Report for 1970-75.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 188p. NTIS PC N01/MF N01.

Worldwide research on beneficiation of coal by washing, grinding, pulverizing, and flotation methods is discussed. Abstracts pertaining to dewatering of fine coal, drying of ultrafine coals, briquetting, agglomeration, and equipment used in coal cleaning plants are included. (This updated bibliography contains 181 abstracts, none of which are new entries to the previous edition.)

32538 (NTIS/PS—77/0886) **Coal beneficiation. Volume 2. 1976-September 1977 (citations from the Engineering Index data base). Report for 1976-Sep 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 135p. NTIS PC N01/MF N01.

Worldwide research on beneficiation of coal by washing, grinding, pulverizing, and flotation methods is discussed. Abstracts pertaining to dewatering of fine coal, drying of ultrafine coals, briquetting, agglomeration, and equipment used in coal cleaning plants are included. (This updated bibliography contains 128 abstracts, 85 of which are new entries to the previous edition.)

CARBONIZATION

REFER ALSO TO CITATION(S) 32599

32539 Expansion of coking coke resources by using preheated coal in horizontal chamber ovens. Habermehl, D.; Beck, K.G. (Bergbau-Forsch, Essen-Kray, Ger). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 10, 436-440(Oct 1977). (In German).

A method of converting abundantly available coal of poor coking quality into blast furnace coke is described. The proposed method, called the precarbon method, is characterized by the coupling of a two-stage forced-flow system for the drying and preheating of the coking coal with a chain conveyor running over the batteries of coke ovens for charging the ovens with the preheated coal. 15 refs.

32540 Practical use of mathematical methods for determining the composition of coal blends. Kaziszyn, I. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland); Lojek, M.; Postrzednik, S. *Koks, Smola, Gaz;* **22**: No. 12, 313-316(Dec 1977). (In Polish).

By applying planned experiment methods relationships were worked out between quality coefficients of coke and the composition of a coal blend. The suitability of this method for blends carbonized in experimental furnaces and under industrial conditions was verified.

32541 Extension of the raw material basis for the coking industry based on improvements of the existing technology and on new methods of coke production. Vasil'ev, Yu.S. *Koks, Smola, Gaz;* **22**: No. 12, 317-320(Dec 1977). (In Polish).

The applications of various sorts of coke are reviewed. Orientation of research work in the USSR is aimed at the extension of the raw material basis for the conventional coking industry (coal crushing, charge predrying and preheating, increase of coking speed, dry quenching of coke). The technology of continuous coal carbonization with the purpose of obtaining formed coke for various applications and of achieving special varieties of carbonized chars is discussed.

32542 Coking and graphitization process of group components of coal tar pitch. Jasienko, S. (Instytut Chemii, Wroclaw); Swietlik, U.; Jastrzebski, J.; Stompel, Z. *Koks, Smola, Gaz;* **22**: No. 12, 321-325(Dec 1977). (In Polish).

Coal tar pitch from the coking plant belonging to the "Lenin" Metallurgical Complex at Nowa Huta and group components separated from it by the Jurkiewicz method were submitted to the coking process at 1273 K and the obtained cokes to the graphitization process at 2273 and 3273 K. Physical and chemical properties as well as the structure of cokes and products of their graphitization were investigated. It was found that coke from the component β optically strongly anisotropic with the highest degree of structure orientation possesses the highest susceptibility to graphitization. On the other hand, coke from the component α_2 optically isotropic with a much lower degree of structure orientation exhibits the weakest susceptibility to graphitization.

32543 Expansion of coking coal resources by the employment of pre-heated coal in horizontal chamber furnaces. Habermehl, D.; Beck, K.G. (Bergbau-Forschung G.m.b.H., Essen (Germany, F.R.)). *Gas-Wasserfach, Gas-Erdgas;* **118**: No. 10, 436-440(Oct 1977). (In German).

With the development of the pre-heating-technique to an operational level, the possibility of expanding the coking coal resources is given. The pre-carbonization process developed by Bergbau Forschung GmbH and Didier-Engineering GmbH, both in Essen, and its results are described. In the case of employment of well-coking coals, all possibilities of increasing the throughput can be utilized by reducing the operation period and increasing the bulk density to more than 60%. Using poor-coking mixtures, a part of this possible throughput increase is lost by reducing the heating temperature.

32544 Studies of the use of preheated coking coal. Meyer, C.; Echterhoff, H.; Habermehl, D.; Beck, K.G. *Glueckauf-Forschungsh.,* **38**: No. 5, 197-202(Oct 1977). (In German).

Studies of the effect of preheating on the coking process and the coke itself showed a correlation between heating flue temperature and coking time. On the one hand, at a given temperature a coking time about one-third shorter than in the coking of wet charges can be attained, which, coupled with a bulk density increase, offers a possibility of increasing the throughput up to 65%. On the other hand, for a given coking time the heating flue temperature can be reduced by about 200 K and the resulting improvements in coke quality can be exploited. 4 refs.

32545 Influence of atmospheric pre-oxidation of some hard coals on the yield of solid products, primary tar, and gas during carbonization. Wachowska, H.; Andrzejak, A.; Kuczynski, W.; Pawlak, W. (Univ., Poznan, Poland). *Koks, Smola, Gaz;* **22**: No. 10, 251-255(Oct 1977). (In Polish).

The amount of oxygen was determined in the form of reactive groupings in coals of various non-oxidized types and those atmospherically oxidized at 100, 150 and 200°C during 300 hours. The percentages of these groupings have been calculated with regard to

the total content of oxygen. Results of investigations are presented concerning the influence of the degree of coal oxidation of different types on the yield of low-temperature carbonization products.

32546 Influence of duration and reversion cycle of coke oven battery heating on their working efficiency. Wasilewski, P. (Politechnika Slaska, Gliwice, Poland); Morawski, J.; Cieslar, R.; Mierzwinski, S. *Koks, Smola, Gaz;* **22**: No. 10, 263-266(Oct 1977). (In Polish).

Possibilities of shortening the duration and reversion cycles of coke oven battery heating are presented from the angle of improving heating economics and increasing productiveness.

32547 (DOE-tr—80) **Technical information on processes for the utilization of coal: the manufacture of shaped coke.** Sep 1977. Translation of German paper. 4p. Dep. NTIS, PC A02/MF A01.

A process for making formed coke from lignite involves several steps which are described. Technical and economic parameters for the production of 1 million tons of coke per year are given based on the results of small pilot plant investigations. (LTN)

32548 Comparison of the quality of blast-furnace coke manufactured by stamped and top charging methods given a definite raw material basis of coals. Dlugosz, A.; Piotrowski, A. (Instytut Energochemii Wegla i Fizykochemii Sorbentow AGH, Krakow). *Koks, Smola, Gaz;* **22**: No. 9, 221-225(Sep 1977). (In Polish).

Results are given of investigations into the influence of coal blends properties on the quality coefficients of coke produced from them by the stamped and top charging methods of charging coke ovens.

32549 Change of physicochemical properties of the coal blend depending on water content. Wasilewski, P.; Patzek, H. (Instytut Technologii Chemicznej Wegla i Ropy Naftowej Politechniki Slaskiej, Gliwice, Poland). *Koks, Smola, Gaz;* **22**: No. 9, 225-228(Sep 1977). (In Polish).

The effects are described of water content on the coking capacity of coal blends, the charge density as well as on the thermal parameters i.e. the specific heat and thermal conductivity. The authors present an interpretation of their own regarding the change of caking properties of various coals in dependence of water content.

32550 Evaluation of tar products from rapid degasification of bituminous coals. Patzek, T. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland). *Koks, Smola, Gaz;* **22**: No. 9, 233-237(Sep 1977). (In Polish).

The low-temperature tar products investigated were obtained in semi-pilot installations at the Institute of Chemical Coal Utilization (IChPW) by fluid-bed and solid heat-carrier techniques. Physical and chemical properties of the materials were studied in order to collect data useful for estimating utilization potentialities of such products as well as for the design of their prospective processing. Further, preliminary tests were conducted on the possible use of the tars as raw material in making pitch coke for electrode manufacture. The results show that pretreatment of the tars will be necessary.

32551 Coal and coke. Beckmann, F.H. (Eschweiler Bergwerks-Ver, Ger). *Rev. Tech. Luxemb.;* **69**: No. 2, 38-45(1977). (In German).

The article reviews and discusses the various types of coal and their characteristic properties, specific features of coking coals, the operation of a conventional coking plant, and the quality and properties of blast furnace coke. Some variants and new improvements of the conventional coking process are also reviewed.

32552 Trials aimed at adapting the Simonis method to predict coke quality from domestic coals. Kaziszyn, I. (Instytut Chemicznej Przerobki Wegla, Zabrze, Poland); Heilpern, S.; Zarembinska, J.; Postrzednik, S. *Koks, Smola, Gaz;* **22**: No. 7-8, 193-198(1977). (In Polish).

For purposes of forecasting coke quality from domestic coals and coal blends, the methods of Simonis, Mackowsky and Simonis as well as that of Falk have been used. In view of considerable differences in the results obtained with regard to the real coke quality, correction coefficients for the Simonis and Falk models have been calculated.

DESULFURIZATION AND PURIFICATION

REFER ALSO TO CITATION(S) 32601, 33392, 33396

32553 Desulfurization of coal by rapid degassing and partial gasification. Hauk, R.; Hedden, K.; Huber, L. (Univ Karlsruhe, Ger). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 10, 427-430(Oct 1977). (In German).

During rapid degassing at temperatures of about 950°C desulfurization of up to 55% is attained within 2 to 4 seconds. An extraordinarily reactive coke is formed which facilitates subsequent gasification. Partial gasification was carried out at temperatures between 1200 and 1550°C in about 0.7 sec and resulted in a carbon conversion of up to 40%. The degree of desulfurization during partial gasification is always higher than the carbon conversion. The sulfur content in the residual coke can be reduced to about 0.6 wt%. The sulfur in the gas is present mainly in the form of H_2S. 1 ref.

HYDROGENATION

REFER ALSO TO CITATION(S) 33397

32554 Utilization possibilities of coal hydrogenates. Szuba, J.; Michalik, L.; Musialski, A. (Instytut Technologii Chemicznej Wegla i Ropy Naftowej Politechniki Slaskiej, Gliwice, Poland). *Koks, Smola, Gaz;* **22**: No. 10, 248-250(Oct 1977). (In Polish).

Possibilities of processing coal hydrogenates are presented. The first variant provides a paraffin-naphthene fraction as raw material for obtaining jet fuel and, besides that, it can be processed to provide benzene, phenols, tetralin, phenanthrene, pyrene as well as diesel and fuel oils. The second variant is aimed at obtaining diesel and fuel oils. The coal hydrogenate itself may be used directly in power engineering as a substitute for fuel oil free of sulphur and ashes.

32555 Partition coefficients of methylpyridines. Zalewski, R. (Instytut Towaroznawstwa Akademii Ekonomicznej, Poznan, Poland); Tomasik, P. *Koks, Smola, Gaz;* **22**: No. 7-8, 203-206(1977). (In Polish).

Partition coefficients of pyridines and their alkyl derivatives between the aqueous phase and the organic one have been determined with the assumption that both phases are mutually insoluble. The selected pyridine compounds may be considered as fundamental basic components produced in hard coal hydrogenation.

GASIFICATION

REFER ALSO TO CITATION(S) 32553, 32865, 32870, 32871, 33244

32556 (BM-RI—8272) **Methanation activity of Raney nickel catalysts. Effect of proportion of $NiAl_3$ and Ni_2Al_3 in precursor alloys.** Oden, L.L.; Russell, J.H. (Bureau of Mines, Albany, Oreg. (USA). Albany Metallurgy Research Center). 1978. 18p. of Mines, Washington, DC.

The Bureau of Mines is developing nickel catalysts for converting synthesis gas derived from coal to synthetic natural gas. The present report describes the relationship between the composition of aluminum-nickel alloys in the composition range $NiAl_3$ to Ni_2Al_3 equilibrated at 840°C and the properties of catalysts obtained from them. Methanation activity was determined in the temperature range of 300° to 360°C in a flowing gas stream containing 1 pct CO, 8 pct H_2, and the remainder He. One part per million of H_2S was added to the gas stream at 400°C to evaluate the susceptibility of catalysts to sulfur poisoning. The total surface area was measured by the adsorption of nitrogen at liquid nitrogen temperature, and the active surface area was measured by the adsorption of hydrogen at room temperature. Total surface area and active surface area were found to increase with increasing proportion of aluminum-saturated Ni_2Al_3 in the precursor alloy, but methanation activity and resistance to poisoning by H_2S were nearly constant. However, the methanation activity of the catalyst prepared from stoichiometric Ni_2Al_3 was less than half that of the other catalysts.

32557 (COO—2960-2) **Electrode polarization studies in hot corrosion systems. Progress report, June 1, 1977—May 31, 1978.** Devereux, O.F. (General Atomic Co., San Diego, Calif. (USA)). Feb 1978. Contract EY-76-S-02-2960. 34p. Dep. NTIS, PC A03/MF A01.

Analysis of thermodynamic models pertaining to coal gasification is near completion. Model I, comprising a gas phase and a molten salt phase, pertains to laboratory materials testing; Model II incorporates as well a solid carbon phase and is intended to model typical gasifier environments. Anodic and cathodic polarization measurements on iron, 1018 steel, nickel, and 304 and 316 stainless steel have been performed in molten sodium carbonate under air and oxygen; tests under reducing environment are in progress. Preliminary metal/gas reactions tests involving iron, and hydrogen sulfide and nitrogen, have been performed. Reaction with nitrogen is minimal; reaction with hydrogen sulfide is very non-uniform, rendering kinetic analysis difficult.

32558 (FE—1514-76) **Advanced coal gasification system for electric power generation. Sixty-fifth monthly progress report, December 1977.** Keairns, D.L.; Salvador, L.A. (Westinghouse Electric Corp., Madison, Pa. (USA)). 3 Feb 1978. Contract EX-76-C-01-1514. 16p. Dep. NTIS, PC A02/MF A01.

Test TP-013-3 was conducted to evaluate gasifier operability with various coal feedstocks. The primary goal of this test was to explore the feasibility of feeding coal directly to the gasifier without the benefit of pretreatment or devolatilization. The candidate coals chosen were a non-caking Wyoming sub-bituminous coal, a mildly-caking Indiana No. 7 coal from the Minnehaha mines and a highly-

caking Pittsburgh seam coal from Consolidation Coal's Champion facility. The free-swelling indices of these three coals were 0, 2 and 8, respectively. The Pittsburgh coal had a Gieseler plasticity of 28,000 ddm. A total of 75 hours of gasifier operation was logged in this test and 50 tons of fuel were processed. Reactor temperatures were held between 1720°F and 1770°F. The heating value of the product gas fell in the range of 69-129 Btu/scf. The ash particles discharged from the agglomerator were angular in shape with ash contents of 37 percent to 69 percent.

32559 (FE—1514-77) **Advanced coal gasification system for electric power generation. Sixty-sixth monthly progress report, January 1978.** Keairns, D.L.; Salvador, L.A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Coal Conversion Dept.). 8 Feb 1978. Contract EX-76-C-01-1514. 11p. Dep. NTIS, PC A02/MF A01.

With the completion of the individual gasifier test reports, attention has been turned to correlating data from all sixteen gasifier tests to evaluate process performance and define scale-up criteria. Efforts were initiated for a similar study with data from the devolatilizer test series. Discussions with Fluidized Bed Research personnel at Westinghouse R and D and a review of their Laboratory program literature identified specific theoretical and empirical models that can be used as an initial basis for comparison of performance parameters. Work was initiated to prepare a hardware evaluation report that will provide a documented history of PDU hardware performance to date, design changes incorporated during the program, and general data and recommendations related to coal gasification plant design. Work has been carried out in the following areas: support tasks for the current PDU combustor-gasifier test program, support tasks for the devolatizer to prepare for integrated plant operation, coal behavior studies, ash behavior studies and reactor analysis.

32560 (FE—1521-56) **Development work for an advanced coal gasification system for electric power generation from coal directed toward a commercial gasification generating plant. Phase II. Quarterly technical progress report, October—December 1977.** Smith, D.E. (Foster Wheeler Corp., Livingston, N.J. (USA)). Mar 1978. Contract EX-76-C-01-1521. 6p. (FWC/FWEC/GQ—010). Dep. NTIS, PC A02/MF A01.

This report summarizes the technical progress resulting from work performed during the period October to December 1977 toward the design and development of a Combined Cycle/Coal Gasification Pilot Plant to produce low-Btu fuel gas from coal. Foster Wheeler Energy Corporation (FWEC) has received a contract modification from DOE under which FWEC will reevaluate its proposed design of the experimental gasifier unit with regard to size, site specificity, etc.; prepare a conceptual design of the gasifier unit; and develop a cost estimate.

32561 (FE—1527-37) **Gas generator research and development TRI-GAS process. Quarterly report, July—September 1977.** (Bituminous Coal Research, Inc., Monroeville, Pa. (USA)). Oct 1977. Contract EX-76-C-01-1527. 48p. (BCR-L—851). Dep. NTIS, PC A03/MF A01.

Four tests were conducted in the PEDU. Stage 3 reactor Tests No. 3S-5 and 3S-8 revealed that ash agglomeration could occur under severe operating conditions such as high oxygen concentration, low fluidization velocity, or shallow fluid beds. The results from Stage 3 reactor, Test No. 3S-6, indicate that Stage 3 could be operated wth Rosebud char at 1800°F with the proper fluidization velocity and the correct air and steam concentration. During the integrated three-stage Tests No. 3S-7 and 3S-9, line PG-33 became plugged with a mixture of fines and condensibles from Stage 1. As a result, the Stage 1 reactor over-pressurized and the tests were terminated. To alleviate this problem, the Stage 1 cyclones have been moved as close as physically possible to the reactor to immediately clean the Stage 1 off gas.

32562 (FE—1545-45) **Low-Btu gasification of coal for electric power generation. Phases I, II, and III. Monthly progress report, January 1—31, 1978.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). 27 Feb 1978. Contract EX-76-C-01-1545. 12p. Dep. NTIS, PC A02/MF A01.

This Progress report describes activities performed under the subject contract during the month of January, 1978. The pDU continued in a standby operational status throughout January while rework of the coal pulverizing and storage system's insulation and heat tracing proceeded. At the end of the month, all the rehabilitation work was sufficiently complete to predict resumption of combustor coal firing early in February.

32563 (FE—1545-46) **Low-Btu gasification of coal for electric power generation. Phases I, II, and III. Monthly progress report, February 1—February 28, 1978.** (Combustion Engineering, Inc., Windsor, Conn. (USA)). 13 Mar 1978. Contract EX-76-C-01-1545. 16p. Dep. NTIS, PC A02/MF A01.

More than twnety four hours of combustor coal firing of the PDU gasifier were logged in the period February 2 through February 4. Included in this operation was one continuous combustor coal firing period of about eleven hours. Slagged ash flow to the slag tank under the gasifier commenced, without assitance, shortly after continuous coal firing was established. Combustor firing was terminated the evening of February 4, because of development of a severe vibration in the system's high speed booster fan and pluggage of the gas side of a heat exchanger (gas cooler) in the product gas duct just ahead of the Stretford absorber. Correction of these and other problems required the rest of the month of February, but the PDU was coming back on stream on the last day of the month for resumption of combustor coal firing in early March.

32564 (FE—2036-19) **Liquid phase methanation pilot plant operation and laboratory support work. Monthly report, January 1978.** (Chem Systems, Inc., New York (USA)). Feb 1978. Contract EX-76-C-01-2036. 18p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

Modifications to the portable methanation pilot plant are detailed. Experiments are planned with different feed gas composition and at different reactor temperatures to determine those conditions which must be avoided to prevent deposition of graphite and non-ideal carbon and to determine temperature controllability. It is known that too high a concentration of carbon oxides cause excessive hot spots because of the highly exothermic nature of methanation. This leads to carbon or graphite deposition and fouling of the catalyst which must be avoided. (LTN)

32565 (FE—2220-15) **Fuel gas cleanup technology for coal gasification. State-of-the-art review and recommendations for development.** Murthy, B.N.; Klett, M.G.; Becker, D.F.; Szwab, W.; Fischer, W.H. (Gilbert/Commonwealth, Reading, Pa. (USA). R and D Div.). 24 Mar 1977. Contract EX-76-C-01-2220. 82p. Dep. NTIS, PC A05/MF A01.

Successful development of the ERDA coal gasification program objectives depends on the availability of economical and effective fuel gas cleanup technology that satisfies the environmental, occupational safety and fuel specification constraints. This report includes a review of the Fuel Gas Cleanup Technology applicable to coal gasification systems for environmental compliance, downstream equipment protection, and fuel gas purification in catalytic methanation. Commercially available desulfurization processes for coal gasification plants are evaluated in terms of product gas end use. Hot gas cleanup technology is under development for removing particulates and sulfur compounds and is evaluated for its potential application to combined cycle power generation. Technological gaps are identified for further research and development in the areas of: fuel gas impurity characterization, high temperature-high pressure sampling and measurement, selective removal of H_2S, hot gas cleanup, catalytic processes for ammonia decomposition, and integration of cleanup processes in coal gasification plants.

32566 (FE—2220-26) **Fixed bed gasification for production of industrial fuel gas.** (Gilbert/Commonwealth, Reading, Pa. (USA). Energy Research Div.). Oct 1977. Contract EX-76-C-01-2220. 184p. Dep. NTIS, PC A09/MF A01.

This report summarizes the results of technical and economic evaluations of six commercially available, fixed-bed coal gasification processes for the production of industrial fuel gas. The study was performed for DOE and is intended to assist industrial companies in exploring the feasibility of producing gaseous fuels for both retrofit and new industrial plant situations. The report includes a technical analysis of the physical configuration, performance capabilities, and commercial experiments to-date for both air-blown and oxygen-blown fixed bed gasifiers. The product gas from these gasifiers is analyzed economically for three different degrees of cleanliness: (1) hot raw gas, (2) dust-, tar-, and oil-free gas, and (3) dust-, tar-, oil-free and desulfurized gas. The evaluations indicate that low-Btu gases produced from fixed bed gasifiers constitute one of the most logical short-term solutions for helping ease the shortage of natural gas for industrial fuel applications because the technology is well-proven and has been utilized on a commercial scale for several decades both in this country and overseas; time from initiation of design to commercial operation is about two years; the technology is not complicated to construct, operate, or maintain; and a reliable supply of product gas can be generated on-site. The advantages and disadvantages of fixed bed gasification technology are listed. The cost of the low Btu gas is estimated at $2 to $4 per MM Btu depending on gas purity, cost of coal ($20 to $50 per ton) and a number of specified assumptions with respect to financing, reliability, etc. (LTN)

32567 (FE—2247-13) **Gasification of residual materials from coal liquefaction. Quarterly report, October—December 1977.** Robin, A.M. (Texaco, Inc., Montebello, Calif. (USA). Montebello Research Lab.). Jan 1978. Contract EX-76-C-01-2247. 11p. Dep. NTIS, PC A02/MF A01.

A 12-pound sample of SRC ash concentrate was received from Kerr-McGee Corp. A Type I Laboratory Evaluation was completed with this material and a report was written. The ash concentrate cannot be melted and, therefore, must be charged to a Texaco gasifier as a slurry. A 55 percent (wt) slurry of ash concentrate in water was judged to be pumpable. Operating conditions and expected product yields for gasifying 1000 pounds per hour of ash concentrate at 350 psig are summarized. About 15 standard cubic feet of hydrogen plus carbon monoxide would be produced per pound of ash concentrate. Because of its high ash content (approximately 41 wt pct), the gasification efficiency will be low on a total solids feed rate basis.

32568 (FE—2428-19) **Development of a particulate control Cyclocentrifuge. Phase II: laboratory tests. Monthly technical progress report No. 19, January 1978—February 1978. Attachment A. Control of alkali metals in low Btu turbine fuel gas using a Cyclocentrifuge.** McCabe, J.T.; Garber, W.; Albrecht, P. (Mechanical Technology, Inc., Latham, N.Y. (USA)). 9 Feb 1978. Contract EX-76-C-01-2428. 25p. Dep. NTIS, PC A02/MF A01.

Attachment "A" of this report has specific recommendations. The Cyclocentrifuge feasibility report showed that the baseline combined-cycle electric power system can be altered to fire 1000°F low BTU fuel gas, rather than low BTU gas at te baseline temperature of 1550°F, and that this temperature reduction can be accomplished without a significant change in the cost per kilowatt hour. The Cyclocentrifuge feasibility report also showed that: The temperature difference from the gasifier outlet to the Cyclocentrifuge inlet can be accomplished economically using a steam-producing heat exchanger; the Cyclocentrifuge can operate safely and efficiently at 1000°F; and the particulate removal capability of the Cyclocentrifuge is more than adequate to prevent erosion of the gas turbine gas path components. The present study, which is concerned with the capability of the Cyclocentrifuge to prevent corrosion and deposit-related turbine damage, concludes the following: All alkali metals in the gas stream that originate from coal fed to the gasifier will be in the solids phase when they enter the Cyclocentrifuge; the alkali metal content of the gas leaving the Cyclocentrifuge and entering the gas turbine combustor will be well below the fuel gas specifications published by gas turbine manufactuerers for restricting machine damage due to corrosion and deposits; and although not needed for particulate removal efficiency, a cyclone should be employed upstream of the Cyclocentrifuge to provide mechanical protection.

32569 (FE—2518-15) **Hydrogasifier development for the Hydrane process. Monthly progress report, January 1978.** Combs, L.P.; Greene, M.I. (Rocketdyne, Canoga Park, Calif. (USA)). 8 Feb 1978. Contract EF-77-C-01-2518. 47p. Dep. NTIS, PC A03/MF A01.

Experimental work continued with Cities Service making seven material balance runs in the bench-scale reactor system. One of these tests reacted Minnesota peat with pure hydrogen under conditions comparable with one of the earlier Rocketdyne peat runs. Five tests were made with methane added to the preheated feed gas when processing subbituminous coal and one test when processing bituminous coal. Experimental effort was also continued on Task 3A with Rocketdyne making seven data-producing material balance runs. Two tests were with subbituminous coal, one each with and without methane added to the feed gas. Four tests reacted a mildly-caking Illinois bituminous coal and one reacted a more-highly caking Kentucky bituminous coal. Four additional runs were attempted but were cut short by plugging problems which were eventually isolated as being caused by partial collapsing of the reactor tube. Design, fabrication and facility preparation efforts leading up to the longer duration testing at 1/4 ton/hr coal feed rates were carried forward. It is still planned to be ready to test by the first of March 1978. Cities Service exercised the process economic computer model of an overall hydrogasification coal conversion plant to examine SNG cost sensitivity to changes in overall carbon conversion, methane recirculation and to elimination of BTX by-product yields.

32570 (FE—2518-16) **Hydrogasifier development for the Hydrane process. Monthly progress report, February 1978.** Combs, L.P.; Greene, M.I. (Rockwell International Corp., Canoga Park, Calif. (USA). Rocketdyne Div.). Mar 1978. Contract EF-77-C-01-2518. 27p. Dep. NTIS, PC A03/MF A01.

Cities Service made five material balance runs in the entrained flow reactor during February. Four runs were with a Western Kentucky No. 9 bituminous coal and the other was with Minnesota peat. Preliminary results from prior runs in which Montana subbituminous coal was reacted with a preheated mixture of 80% H_2/20% CH_4 indicated that hydrogen partial pressure, rather than total pressure, is a key parameter influencing total carbon conversion. Rocketdyne made two runs with Kentucky No. 9 bituminous coal in the 1/4-ton/hr reactor system. One test, at nominal reactor conditions of 1500 psig, 1900 F and 3500 msec residence time, resulted in virtually total gasification of all of the carbon that was converted; the only liquid-product species identified was a small amount of benzene vapor in the product gas samples. Several computer runs were made to investigate effects on the cost of gas of: (1) plant size (SNG yield), (2) hydrogen/coal ratio, and (3) reactor effluent quench mode with Montana subbituminous and Kentucky bituminous coals processed at conditions producing minimal liquid by-products. Among these runs, the 10-year average, utility-financed SNG costs predicted ranged from $3.39 to $5.84/MM BTU, with the lowest cost resulting from subbituminous coal reacted at the lowest hydrogen/coal ratio in the largest plant and utilizing a heat recovery quench.

32571 (FE—2565-11) **Analysis of coal hydrogasification processes. Monthly technical progress report, 1 January—31 January 1978.** (Bechtel Corp., San Francisco, Calif. (USA)). Feb 1978. Contract EF-77-A-01-2565. 37p. Dep. NTIS, PC A03/MF A01.

Data from four recent Rocketdyne hydropyrolysis tests with subbituminous coal and 24 recent Rocketdyne partial liquefaction tests with bituminous coal were entered into the computerized data base. The Rocketdyne data base was expanded to include calculated values for carbon selectivity to methane, ethane, and BTX. The PERC data base was also expanded to include calculated values for gas velocity, gas residence time, and carbon selectivity to gas, methane, and ethane. The semiempirical correlation for predicting carbon conversion efficiency was fitted to the Cities Service and Rocketdyne Subbituminous coal data. The analysis showed that the Cities Service bench-scale reactor and the Rocketdyne 1/4-ton/hr reactor give similar carbon conversions under comparable operating conditions. An improved semiempirical correlation was presented for predicting overall carbon conversion, which also accounts for thermodynamic equilibrium between the coal and reaction products.

32572 (MERC/SP—78/2) **Chemistry of hot gas cleanup in coal gasification and combustion.** (Department of Energy, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Feb 1978. 252p. Dep. NTIS, PC A12/MF A01.

Hot gas contaminant control and cleanup in the gasification process or gasifier product stream holds the promise of mitigating materials problems which currently prevent combined-cycle application of low Btu gas, and of eliminating these problems in a manner which is directly thermally efficient and which does not generate subsidiary materials or disposal problems. The conception, development, and selection of hot gas cleanup techniques requires a detailed knowledge of the origin, chemical state, and levels of contaminants in process streams as a function of feed coal composition, process temperatures and residence times and other controlling parameters; levels to which the identified contaminants can be conditioned or removed along the process stream and the energy penalties for such control; and levels to which the contaminants must be controlled to meet mandated emission constraints or to prevent unacceptably rapid attrition of strategic process materials (e.g. turbine blades or boiler tubes). This report is a preliminary review of the chemistry of sulfur, nitrogen, alkali, halogen, and aluminosilicate compounds which can occur as vapors or associated with particulates in gasification and combustion atmospheres. Tars are briefly considered. Primary emphasis is given to equilibrium thermodynamic information regarding the formation, phases, chemical states, reactions, and disposition of these substances. Limited kinetics information is considered. Some selected conditioning or cleanup techniques are reviewed and new techniques recommended.

32573 (ORNL/TM—6217) **Coal Technology Program. Progress report for November 1977.** (Oak Ridge National Lab., Tenn. (USA)). Jan 1978. Contract W-7405-ENG-26. 52p. Dep. NTIS, PC A04/MF A01.

A block of Pittsburgh seam bituminous coal and a block of Wyodak subbituminous coal were pyrolyzed under reducing gas in support of in situ gasification. Information from previously completed block pyrolysis of bituminous coal under an argon atmosphere show that differences in evolved gas result from differences in heating rates. Compared to block pyrolysis at 0.3 C°/min, block pyrolysis at 3 C°/min produces less gas but gas with a higher heating value, yielding a higher overall pyrolysis gas efficiency in recovering coal heating value. Experimental work on the fracture toughness and tensile properties of steels that may be used for piping and pressure vessels in very large gasification systems continued. The toughness of quenched 2¼ Cr-1 Mo steel simulating the surface of a 254 to 305 mm-thick plate was measured, and the differences in toughness and tensile properties following two temperature treatments were determined. Post-weld heat treatment effects were also characterized. All properties remained within the range for ASME SA 387, Grade 22, Class 2 material. Work on inspection techniques for ceramic and cermet coatings is being closed out by completing and updating reports in various draft stages. Work is underway to establish a program for testing coal feeders under development by DOE/FE. Jet Propulsion Laboratory has recommended five feeders for testing. (LTN)

32574 (ORNL/TM—6262) **Coal Technology Program. Progress report for December 1977.** (Oak Ridge National Lab., Tenn. (USA)).

Feb 1978. Contract W-7405-ENG-26. 59p. Dep. NTIS, PC A04/MF A01.

In the pressure vessel and piping materials work, the report, "Assessment of Materials Technology for Gasifer and Reaction Pressure Vessels and Piping for Second Generation Commercial Coal Conversion Systems" (ORNL-5238), has been submitted for publication and distribution. Impact and tensile teting is under way on 2¼ cr-1 Mo steel which has received a simulated quench, temper, and postweld heat treatment. Two topical reports on coating inspection have gone to reproduction. CoCrAlY material has been received and specimen production has been initiated. We are streamlining our methods for eddy-current design and have developed a new method for material characterization. A penetrant procedure for cermet coatings has been optimized and some interesting observations of coating behavior were made during the tensile cracking of a cermet specimen. In the welding and cladding program, experimental gas metal-arc weld-clad depits of type 320 Cb stainless steel have been made on an intermediate layer of Inconel 82 (primary substrate material is steel). Metallographic and micoprobe examination of tubes from the 1500-hr FluiDyne AFBC fireside corrosion test showed mild oxidation on both the ID and OD, no indication of sulfidation attack, and very slight intergranula corrosion. Examination of various valve components and air distributor plates from operating plants is under way in the failure analysis work. (LTN)

32575 (TID—28147) **Coal pump development and technical support. Monthly project report, 3 October—30 October 1977. Report No. 5.** Murphy, A. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 9 Nov 1977. Contract EF-77-A-01-2616. 22p. (TSR—77/5). Dep. NTIS, PC A02/MF A01.

Support to the DOE Coal Feed Program is provided by analysis of coal-feeding requirements for scaled-up coal plants with particular emphasis on pressurized converters; formulation of engineering and performance criteria to guide the subsequent selection, development, and commercialization of coal-feeder systems; monitoring the technical progress of feeder developments, including evaluation of performance of ongoing coal-feeder programs and comparison of development progress against the criteria; and formulation of recommended program plans for the development of selected feeder systems. A study of pilot and planned demonstration facilities will be made to identify equipment deficiencies for demonstration facilities and recommend equipment development actions. A base of engineering experience in the continuous extrusion of coal in the plastic state through use of a modified thermoplastic extruder will be used to assess the feasibility of developing large commercial-size coal feeding systems based on this approach.

32576 (TID—28266) **British Gas Corporation, Westfield Development Centre, technical support programme, report on run TSP001.** Scott, J.E. (British Gas Corp., Cardenden. Westfield Development Centre). 28 Sep 1977. Contract EF-77-C-01-2542. 38p. Dep. NTIS, PC A03/MF A01.

Run TSP001 was the first run of a new program and the main objective was to commission the gasifier and its systems, both of which had undergone considerable overhaul and modification since the last test series. Important secondary objectives were to commission the newly installed fluxing system, to investigate the behavior of the gasifier on lower than normal loads and to run the gasifier briefly under the conditions projected for running on Ohio 9 coal during TSP002. Slagging gasification after a standard start up procedure and the gasifier ran for two days under these conditions to establish the integrity of the refurbished reactor and its systems. With the gasifier on standard loading, the fluxing system was commissioned, with enough flux (blast furnace slag) to increase the coal ash by approximately 15% being mixed with the coal as it flowed. This system worked successfully, with little effect on gasifier performance, slag tapping still being an easily controlled operation. After the fluxing period, low load trials were commenced with the gasifier loading being brought down in a stepwise fashion to 122,000 SCF/H oxygen over 16 hours. Steam/oxygen ratio and gasifier pressure remained constant at 1.35 and 350 psig. The load was later returned to 130,000 SCF/H oxygen. Post run inspection revealed that good conditions had prevailed in all gasifier systems and internals and no repairs or modifications to the gasifier itself will be required for TSP002. All run objectives were achieved.

32577 VEW coal conversion process: first test results from the 1 t/h pilot plant. Weinzierl, K.; Poller, J. (Vereinigte Elektrizitaetswerke Westfalen A.G. (VEW), Dortmund (Germany, F.R.)). *Gas-Wasserfach, Gas-Erdgas;* **118**: No. 10, 431-436(Oct 1977). (In German).

The first test results of the 1-t/h pilot plant show that the VEW coal conversion process fulfils the expectations in connection with fuel-desulfurization and fuel gas production for use in the efficient gas-steam-turbine process, thus representing a profitable alternative to the conventional current production from hard coal. Furthermore, a combined synthesis gas and current production is offered by the use of oxygen as oxidation agent. The synthesis gas produced in this way can serve as a substition for conventional hydrocarbon carriers in the chemical industry.

32578 Methanization of co/h_2 mixtures in fluidized bed reactors. Lommerzheim, W. (Thyssengas, Duisburg-Hamborn, Ger). *Gas-Wasserfach, Gas-Erdgas;* **118**: No. 10, 417-421(Oct 1977). (In German).

Pilot-plant studies have shown that single-stage combined conversion and partial methanization in a fluidized bed reactor is a suitable method for producing substitute natural gas (SNG) from coal gasification gases. The design of the pilot plant, which has a capacity of 100 to 200 m^3 SNG/hr, is described. In addition, results of fluid dynamics studies are presented which show that fluidized catalyst beds up to 3 meters high can be operated reliably over a wide range of gas flow rates and that catalyst attrition remains within acceptable limits.

32579 Vew coal conversion process: initial test results from the 1 ton/hr pilot plant. Weinzierl, K.; Poller, J. (Ver Elektrizitaetswerke Westfal, Dortmund, Ger). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 10, 431-436(Oct 1977). (In German).

The initial test results from a 1 ton/hr pilot plant show that the coal conversion process developed by Vereinigte Elektrizitaetswerke (VEW) fulfills the requirements with regard to fuel desulfurization and the generation of a fuel gas suitable for use in the high-efficiency combined cycle gas- and steam-turbine process and thus constitutes an economical alternative to conventional power generation from coal. In addition, owing to the use of oxygen as the oxidizer, a combined process of synthesis gas production and power generation is made possible, in which the synthesis gas thus produced from coal can be used in the chemical industry or steel industry as a substitute for conventional hydrocarbon carriers. 2 refs.

32580 Gasification of coal. Gaussens, P. (Gaz de Fr). *Rev. Energ.;* **28**: No. 296, 162-175(1977). (In French).

The problem of production of substitute natural gases (SNG) from coal is reviewed describing the Lurgi process and the U.S. industrial plans in this respect. The second-generation processes that are in the most advanced stage of development, such as HYGAS, BI-GAS, CO_2 ACCEPTOR, SYNTHANE, HYDRANE and COALCON are described and their efficiency and the investment costs required are discussed. Third-generation processes utilizing nuclear heat are considered. Problems of underground gasification are analyzed. It is concluded that SNG produced from coal, will assume greater importance in the times ahead and that national and international cooperation in this field is desirable.

LIQUEFACTION

REFER ALSO TO CITATION(S) 32554, 32567, 32573, 32574, 32589, 32870

32581 (FE—1517-59) **Coal Liquefaction Pilot Plant Cresap, West Virginia. Monthly technical progress report, December 1977 .** (Fluor Engineers and Constructors, Inc., Irvine, Calif. (USA)). Feb 1978. Contract EX-76-C-01-1517. 15p. Dep. NTIS, PC A02/MF A01.

An abbreviated 55-hour extraction run was completed in December; 15 tons of coal were processed as a 15 percent slurry. The depth of extraction was 62 percent. The revised extract disposal system operated satisfactorily. Coal processing was abruptly terminated when the lower extractor agitator shaft seal failed, bringing an end to Run 004. Warm solvent has been circulated through most of the hydrotreating section of the pilot plant under a 2700 psig nitrogen blanket. Leaks at the heads of the absorber and the entrainment separator persisted beyond the end of the month. Much of January is scheduled for maintenance and modification in the hydrotreating section. In addition to the repair of leaky vessels and Conval valves, the attritor loops will be removed from the two hydrogenation reactors as requested by the licensor. An apparent high phenol level of the treated industrial waste water discharge to the Ohio River exceeded EPA limits during December. An extensive effort to define and resolve the problem has begun.

32582 (FE—2260-17) **H-Coal Pilot Plant. Phase II. Construction. Phase III. Operation. Monthly report No. 17, January 1978.** (Ashland Synthetic Fuels, Inc., Ky. (USA)). 20 Feb 1978. Contract EX-76-C-01-2260. 119p. NTIS, MF A01.

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All of ASFI's construction subcontractors suffered setbacks due to the severe weather during January. The mechanical completion of most sections of the pilot plant is now predicted to be March 31, 1979. Engineering work on various projects is detailed. Concerning environmental activities, the Kentucky EPA requires ASFI to propose an SO_2 emission offset for the pilot plant and has stated there must be an emission reduction in the S-217 oil mist eliminator. They have also requested ASFI to investigate alternate means for controlling particulate emissions from the S-104 baghouse. The H-Coal pilot plant is now required to obtain state water permits since

the passage of the Clean Water Act Amendments. Work is continuing on the preparation of computer programs which will be used to predict H-Coal Pilot Plant performance and to analyze pilot plant results. Work continues on the Operations training manuals; at month's end, the training manuals for Sections 200 and 400 are 85% complete. A report specifying analytical laboratory support requirements for the pilot plant is complete.

32583 (FE—2260-18) **H-Coal Pilot Plant. Phase II. Construction. Phase III. Operation. Monthly report No. 18, February 1978.** (Ashland Synthetic Fuels, Inc., Ky. (USA)). 20 Mar 1978. Contract EX-76-C-01-2260. 146p. Dep. NTIS, PC A07/MF A01.

Inclement weather continued to limit the progress of all ASFI construction subcontractors. The planned completion date remains at March 30, 1978. All Phase I engineering tasks and accompanying reports are scheduled for completion by mid-May. The letter of intent to Lummus for the Waste Oil Recovery Unit has been extended to an $80,000 limit to continue expediting engineering. Emission offset requirements for the pilot plant may be bypassed if Kentucky incorporates EPA's Interpretative Ruling into their analysis of the H-Coal plant. Work continues on computer programs which will be used to predict pilot plant performance and analyze pilot plant results. An updated catalyst requirement schedule and an updated coal delivery schedule were established for the operating program. Progress on the training manuals continued on schedule.

32584 (FE—2306-9) **Research and development of an advanced process for the conversion of coal to synthetic gasoline and other distillate fuels. Quarterly progress report No. 3, November 1976—January 1977.** Schneider, A.; Hollstein, E.J.; Janoski, E.J.; Chong, V.M. (Suntech, Inc., Marcus Hook, Pa. (USA). Research and Engineering Div.). Nov 1977. Contract EX-76-C-01-2306. 44p. Dep. NTIS, PC A03/MF A01.

It is concluded that: The Sun catalyst, 1 percent CoO-2 percent MoO_3 on granular bauxite is as active as the best previously tested catalyst, Filtrol HPC-5. The Sun catalyst causes less cracking and less formation of methane. Its use thus results in a more efficient utilization of hydrogen. The Sun catalyst apparently promotes the formation of a larger proportion of basic nitrogen in the total nitrogen remaining in the liquid product. This should result in a more efficient removal of nitrogen from the product by treatment with hydrogen chloride. Hydrogenated anthracene oil is preferable to non-hydrogenated anthracene oil as a solvent for the dissolution and hydrogenation of Illinois No. 6 coal. Hydrogenated anthracene oil provides a greater depth of hydrogenation of the coal-derived liquid portion of the product. Stripped solvent-refined coal filter feed can be hydrogenated successfully but subsequent solids removal may be a problem. Sufficient data have been obtained concerning rates of hydrogenation, product characteristics, etc., to undertake design of 1-3 lb/hr. continuous, bench-scale hydrogenation unit. A stirred tank reactor is preferable to a plug flow tube reactor for the 1-3 lb/hr continuous bench-scale unit.

32585 (FE—2547-14) **Phase II laboratory support for H-Coal project. Monthly progress report No. 14, January 1978.** Comolli, A.; Battista, C.; Bernard, R.; Johanson, E.; Karolkiewicz, W.; Reynolds, M.; Weber, C. (Hydrocarbon Research, Inc., Lawrenceville, N.J. (USA)). Feb 1978. Contract EF-77-C-01-2547. 30p. NTIS, MF A01.

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The PDU was inspected for deposits and erosion following PDU Run 6, a 30-day syncrude operation on Wyodak coal simulating conditions per the Pilot Plant Technical Management Plan. The H-Coal reaction section had no deposits and the catalyst flowed freely from the reactor. Deposits were found at the vapor-liquid interface and at the recycle cup sections of the reactor. Some deposits were also found at the separator liquid inlet, and in the catalyst addition tube. None of the deposits showed an excess of calcium as has been the case of other processes. No measurable evidence of erosion was found during ultrasonic inspection of the reactor and associated piping. The first of five catalyst evaluation tests on a bench-unit scale has been successfully completed using American Cyanamid HDS-1442A, 1/16" extruded catalyst. Run 2, using nickel-moly catalyst, has been started. Work is proceeding on PDU modifications to closely model operation of the Pilot Plant, including an on-line solvent deashing system.

32586 (FE—2566-11) **Upgrading of coal liquids. Monthly technical progress report, January 1977.** Tan, G.; deRosset, A.J. (UOP, Inc., Des Plaines, Ill. (USA). Corporate Research Center). 1978. Contract EF-77-C-01-2566. 19p. Dep. NTIS, PC A02/MF A01.

Hydrotreating process variable studies on EDS gas oil were continued at 250 psig below base pressure. Three more series of studies have been made. Experiments were conducted at 5°C below base temperature, 11°C and 25°C above base temperature, and three space velocities. In all cases heptane insolubles were completely converted and substantial amounts of nitrogen were removed. Nitrogen conversion varied from 85.3 to 99.9 wt-%, depending on conditions employed. Preparation of the second H-Coal FCC charge stock has been completed. FCC studies were carried out on H-Coal gas oil and two hydrotreated H-Coal gas oils. Preliminary results show that the hydrogen content of the feed is the dominant factor on yield data. Total conversions as high as 81 vol-% were obtained.

32587 (FE/8008—1) **Development of improved Fischer—Tropsch catalysts for production of liquid fuels. Final report.** Madon, R.J.; Bucker, E.R.; Taylor, W.F. (Department of Energy, Morgantown, W.Va. (USA). Morgantown Energy Research Center). Jul 1977. Contract EY-76-C-21-8008. 174p. Dep. NTIS, PC A08/MF A01.

An experimental study was conducted in a tubular, packed-bed reactor system to investigate the effects of adding sulfur to catalysts for the Fischer-Tropsch synthesis. Small amounts of sulfur were added to precipitated cobalt, iron, and alumina-impregnated ruthenium catalysts before CO hydrogenation was carried out. Non-traditional catalysts, molybdenum-based and tungsten-based catalysts, were also tested in the oxidized and sulfided forms. The results on all the catalysts used in this study are discussed in this report. In particular, the results of unsulfided and sulfided catalysts are compared, and in several cases distributions of condensed products are represented graphically. Besides sulfur-catalyst interactions, it was noted that there were often significant interactions of process conditions with different sulfided and unsulfided catalysts. Care was taken to minimize the effects of transport phenomena on the catalytic studies.

PYROLYSIS AND CRACKING

32588 **Coal pyrolysis at fire-level heat flux.** Lee, C.K.; Singer, J.M.; Chaiken, R.F. (US Bur of Mines, Pittsburgh, Pa). *Combust. Sci. Technol.;* **16**: No. 3/6, 205-213(1977).

This paper describes an experimental study of the pyrolysis of relatively large samples of Pittsburgh Seam bituminous coal, a high quality coking coal. A one-dimensional laser heating technique is employed to simulate fire-level surface heat flux. The sequential reaction steps of volatilization and coke formation are diagnosed by means of temperature and pressure probes, and continuous weight loss and local density measurements. Analysis of these data yields localized as well as overall heats and rates of reaction. 15 refs.

SOLVENT EXTRACTION

32589 (EPRI-AF—699) **Gas extraction of a western sub-bituminous coal. Final report.** Williams, D.F.; Martin, T.G. (National Coal Board, Stoke Orchard (UK). Coal Research Establishment). Feb 1978. 23p. Dep. NTIS, PC A02/MF A01.

The British National Coal Board has developed a technique for the extraction of UK bituminous coals with supercritical fluids, whereby an extract is obtained which can be hydrocracked to a distillate oil rich in benzene derivatives, together with a reactive char suitable for gasification or combustion. No hydrogen is needed for the extraction, the need for wet filtration to separate the coal solution and the extraction residue is avoided, and virtually complete recovery of the solvent is achieved. The technique has been applied in the laboratory to a high-volatile low-sulfur subbituminous coal from the Western United States. A 20% yield of extract similar in composition (but lower in yield) to UK coal extracts was obtained using supercritical toluene as solvent. The extract had a hydrogen content of 8% and a calorific value of 37500 KJ/kg, compared to 5% and 29500 KJ/kg, respectively, for the coal. The char product was obtained as reactive free-flowing particles. Extraction of the Wyodak coal with a supercritical p. cresol/water mixture yielded approximately 40% extract, but decomposition of the p. cresol occurred giving rise to a further quantity of extract-like material.

32590 **Ultrasounds applied in the process of coal extraction.** Lesniak, K. (Instytut Energochemii Wegla i Fizykochemii Sorbentow AGH, Krakow); Firek, A.; Wolszczak, J.; Kotowski, C. *Koks, Smola, Gaz;* **22**: No. 7-8, 198-200(1977). (In Polish).

Results of investigations into the extraction of coal of rank 33 which has previously been submitted to the action of ultrasonics are presented.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 32588, 32700

32591 **Transportation and preparation of coke oven raw gas at elevated temperatures.** Ehnert, W.; Gebert, F.; George, D.; Huck, G. (Bergbau-Forsch, Essen-Kray, Ger). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 10, 441-444(Oct 1977). (In German).

Tests have shown that it is possible to transport coke oven raw gas at temperatures above 450°C. Owing to expansion and material problems a larger pipeline must be coated. Every effort should be made not to let the temperature fall below 450°C; if need be, the temperature level can be raised by the addition of small quantities of air, thus preventing the condensation of pitch and tar

due to partial oxidation of hydrocarbons. Another way of handling the gas, by removing it at 150°C from the receiver and recovering higher-boiling tar fractions and then subjecting it to partial oxidation in oscillatory burners, seems easier to carry out.

32592 Role and choice of binders to obtain formed active carbon. Chodynski, A.; Sonelski, M. (Osrodek N/B Badan Fizyko-Chemicznych GIG, Katowice, Poland). *Koks, Smola, Gaz;* **22**: No. 10, 256-263(Oct 1977). (In Polish).

Tests were carried out aimed at obtaining active carbons from hard coals and charcoals, semi-coke from hard coal, wood and coal tars as well as petrochemical products. Criteria of choosing binders for obtaining formed active carbons are initially proposed on the basis of determining the influence of the fundamental material and the binder on the mechanical properties, the porous structure and the chemical character of the product.

PROPERTIES

REFER ALSO TO CITATION(S) 32540, 32542, 32545, 32548, 32550, 32553, 32659, 32969

32593 (COO/2871—1) **Chemomechanical phenomena in the grinding of coal. Final report, February 1, 1976—May 31, 1977.** Macmillan, N.H. (Pennsylvania State Univ., University Park (USA). Materials Research Labs.). Aug 1977. Contract EY-76-S-02-2871. 114p. Dep. NTIS, PC A06/MF A01.

Vickers microhardness, drilling rate, grinding rate and zeta-potential measurements have been made on coals of various rank in both aqueous and organic environments in order to determine whether: (a) chemomechanical (Rebinder) effects exist in coal; and (b) any such effects as do exist can be used to improve the comminution of coal. The results reveal the mechanical behavior of coal to be remarkably environment-insensitive as compared to inorganic nonmetals. As a result, it is concluded that chemomechanical phenomena offer little prospect of reducing the cost of comminuting coal.

32594 (LA—7100-MS) **Trace element distributions in several coal conversion processes: an exchange program between the Los Alamos Scientific Laboratory and the National Coal Board of England.** Williams, J.M.; Hensley, W.K.; Wewerka, E.M.; Wanek, P.L.; Olsen, J.D. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1978. Contract W-7405-ENG-36. 26p. Dep. NTIS, PC A03/MF A01.

This manuscript summarizes element data obtained by neutron activation analysis of samples from three National Coal Board (England) processes. These processes include fluidized bed combustion, pressurized fluidized bed combustion, and solvent extraction. A hypothesis to explain the behavior of the elements is also given. In summary, the escape tendency of elements through a conversion system can be predicted from the behavior of the mineral in which they occur. The behavior of a mineral can be predicted from four parameters. The most important ones are volatility, particle size, particle cohesive strength, and oxygen reactivity. Proper consideration of these variables can lead to reasonable predictions of trace-element behavior.

32595 (LBL—5997) **Interaction of a sub-bituminous coal with a strong acid and a strong base.** Seth, M.; Vermeulen, T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1977. Contract W-7405-ENG-48. 110p. Dep. NTIS, PC A06/MF A01.

The interaction of a Wyoming subbituminous coal with molten phosphoric acid containing catalytic additives, and also with molten sodium hydroxide containing catalytic additives, has been studied at 200°C under hydrogen at atmospheric pressure. Treated coal was recovered from the melt by dilution with water and subsequent filtration. Phosphoric acid treatment resulted in a product that had phosphorus incorporated into the organic coal matrix (up to 2.4 wt% in 4 hr). The products showed little desulfurization or deashing, and a much reduced mechanical strength, compared to raw coal. Benzene extractability of the melt-treated coal increased to a maximum of 3.79 wt% (compared to 1.85% for untreated coal) in the first half-hour of reaction, and then declined on further treatment to reach 2.28% in 4 hr. None of the additives tested resulted in benzene extractability greater than the maximum obrained with phosphoric acid alone. Extracts from acid-treatment experiments were characterized by mass spectrometry, ir, uv, and nmr; these extracts contained no aromatics, and thus were similar to extracts obtained in an earlier study with zinc chloride melts. Sodium hydroxide treatment of Wyodak coal resulted in a product similar to the original coal, both in appearance and mechanical strength. X-ray fluorescence analysis indicated up to 50% desulfurization. Because the amounts of material extracted by organic solvents are so small under these experimental conditions, the results cannot be used to draw general conclusions about the chemical structure of this coal or of liquefaction products from it.

32596 Determination of elemental sulfur by gas chromatography. Richard, J.J.; Vick, R.D.; Junk, G.A. (Ames Lab., IO). *Environ. Sci. Technol.;* **11**: No. 12, 1084-1086(Nov 1977).

Elemental sulfur was determined by combining electron capture detection with cyclohexane extractions of coal, particulate, and soil samples and with resin sorption of water samples. The sensitivity for sulfur permitted its determination in environmental samples at sub parts per billion levels. The extraction procedures allowed for a minimum of cleanup prior to the rapid and selective gas chromatography.

32597 Continuous radiometric determination of bulk density for monitoring the preparation of dry brown coal during briquetting. Schaefer, H.G.; Wesemann, U. (Tech Hochsch, Aachen, Ger). *Glueckauf-Forschungsh.;* **38**: No. 5, 192-196(Oct 1977). (In German).

Studies have shown that the grain structure of dry brown coal not only has a considerable effect on the briquetting strength but also on the energy expenditure required for briquetting. Monitoring the grain structure is of particular importance, since the attainment of a high briquetting strength with comparatively low energy consumption depends on this variable. A radiometric bulk density determination based on the irradiation method is suitable for such monitoring. A measurement apparatus developed according to this principle, owing to its higher accuracy in comparison with conventional methods and the possibility of continuous determination of the bulk density over the entire range of application offers possibilities of further improving control techniques in the preparation of brown coal. 4 refs.

32598 Model approach to problems of coal size distribution of coal blends. Wasilewski, P.; Mianowski, A.; Kobel-Najzarek, E. (Instytut Technologii Chemicznej Wegla i Ropy Naftowej Politechniki Slaskiej, Gliwice, Poland). *Koks, Smola, Gaz;* **22**: No. 7-8, 185-193(1977). (In Polish).

A comparison is made of ways of determining optimum grain size distribution of coal blends. It was found that there are substantial differences between fragmentation applied in industrial practice and a model approach to optimum grain compositions of coal blends by the W. Simonis method. The inadequacy of the W. Simonis method is explained by means of assumed functions of grain distributions which are being widely applied in practice.

32599 Examination of group components of tar obtained through rapid coal carbonization in a fluidized bed using ir-spectroscopy. Hodorowicz, S. (Univ., Krakow); Jastrzebski, J.; Tengler, S. *Koks, Smola, Gaz;* **22**: No. 7-8, 200-203(1977). (In Polish).

Spectrophotometric examinations have shown that spectra obtained for individual group components resemble each other. Essential differences are observed first of all in the band intensity. From the characteristics of the bands it follows that the investigated group components consist mainly of condensed aromatic arrangements with small quantities of aliphatic sub-groups. The condensation degree of these arrangements is at its lowest in the case of the γ group component.

32600 (DOE-tr—81) **Offer of information on utilization of coal petrological and supplmental methods of investigation for the evaluation of the technological processing characteristics of soft lignites.** Suess, M. 1977. Translation of pp 1—5, Brennstoffinstitut Freiberg of the VEB Gaskombinat Schwarze Pumpe, Freiberg, March 1977. 11p. Dep. NTIS, PC A02/MF A01.

The German Democratic Republic (GDR) offers comprehensive, scientifically-based experience in the development and practical application of coal petrographical methods of investigation for the determination of technological processing characteristics of soft lignites. The know-how to be disclosed consists of the presentation of the methodical steps which have been confirmed under conditions of the coal industry in our country for the use of coal petrological and supplemental methods. These steps comprise rank determination of the biochemical degree of coalification (type of deposit); material determination of the varieties and lithotypes of lignite; and application of the rank and material determination for the evaluation of the technological processing characteristics of the lignites in research studies and under production conditions. The offer embraces the following scope of delivery and performance: disclosure of the coal petrological methodology used in the GDR, including the correlation relationships for coal processing as well as presentation of supplemental methods of investigation and carrying out of orienting coal petrological investigations on samples of lignite which are furnished by the acceptor of the offer, and interpretation of the results with respect to the possibilities of using these lignites in the thermophysical as well as thermochemical processing of coal.

WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 32703, 32977, 33495, 33574

32601 (BNL—50750) **Regenerative process for desulfurization of high temperature combustion and fuel gases. Quarterly progress report No. 6, July 1—September 30, 1977.** Yang, R.T.; Albanese, A.S.; Chen, J.M.; Farber, G.; Kainz, F.B.; Pruzansky, J.; Shen, M.S.; Smol, R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 36p. Dep. NTIS, PC A03/MF A01.

The Brookhaven Regeneration Process, which comprises reacting the sulfated limestone with fly ash from a FBC in a solid-solid contacting kiln-type reactor, has been shown to be more promising than other processes currently under development. Much improvement can be made by optimizing the operating conditions which are primarily: gas flow rate, degree of agitation (rpm), additives (both solids and gases, e.g. steam), types of carbon, etc. TGA kinetic studies also showed promising results. Cyclic studies, involving the kiln regenerator and a quartz fluidized-bed sulfator, are being conducted for both cyclic reactivity and attrition information. Various dicalcium silicates have been studied for their reactivities for sulfation. Most of the dicalcium silicates (formed in our laboratory and obtained from various sources) showed equal or higher sorption reactivities than lime, on a weight SO_2 per weight sorbent basis. More reactive calcium silicates are being sought, as well as the means of forming them. Highly encouraging results on the regenerabilities of the calcium silicates from their sulfated states are reported. For all the mono- and dicalcium silicates studied, the regeneration rates are about an order of magnitude higher than that of lime or limestone, in both straight thermal decomposition and regeneration with carbon. Other efforts involve studies on catalytic sulfation; calcination of limestones in atmospheres containing steam or CO_2, which increases the reactivities of the calcined stones significantly; kinetics in pressurized FBC; and the development of silicate-based synthetic sorbents.

32602 (CONF-771072—7) **Relative availability of selected trace elements from coal fly ash and Lake Michigan sediment.** Alberts, J.J.; Burger, J.; Kalhorn, S.; Seils, C.; Tisue, T. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 17p. Dep. NTIS, PC A02/MF A01.

From 3. international conference on nuclear methods in environmental and energy research; Columbia, MO, USA (10 Oct 1977).

The concentration of greater than 1 μm coal fly ash particles in Lake Michigan surface waters was found to be 10^5 to 10^6 per liter. With an expected residence time of one year, this concentration implies a flux to the sediment of 10^6 to 10^7 particles/cm^2/yr, or about 10^{-6} to 10^{-5} g/cm^2/yr. The release of trace elements from fly ash and sediment has been studied using Chelex-100 resin to simulate leaching at high dilutions in natural media. Mn, Pb and Zn, but not Fe, are released more readily from Lake Michigan sediment than from fly ash.

32603 (CONF-7705111—, pp 19p, Paper 17, Set No. 4) **Solidification of fine coal refuse.** Snyder, G.A. (Dravo Lime Co., Pittsburgh); Zuhl, F.A.; Burch, E.F. 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Dravo Lime Company has been experimenting for three years on the stabilization of fine coal refuse using the patented Calcilox Additive Process. About two dozen samples of refuse from mines in Pennsylvania, Ohio, West Virginia, Virginia and kentucky have been successfully stabilized. As a result of this experience, a large scale demonstration project was performed at Island Creek's Virginia Pocahontas No. 4 mine. Three hundred cubic yards of thickener underflow slurry were hardened in a temporary holding pond to strengths of up to 170 psi in unconfined compression. Permeability coefficients as low as 2.0×10^{-7} cm/sec were attained. The stabilized refuse was easily excavated from the curing pond and immediately compacted to a density of more than 75 pounds/cubic foot with 2—3 passes of a bulldozer. The stabilized slurry (now solid) absorbed at least 15 passes of the bulldozer with no liquefaction.

32604 (CONF-7705111—, pp 12p, Paper 24, Set No. 4) **Disposal of coal refuse slurry underground.** Jankousky, C.K. (Freeman United Coal Mining Co., West Frankfort, IL). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Experience in back-filling mineral wastes as a slurry containing 5.3 percent solids into a dry cavity and into a flooded area are described. In the dry cavity the deposition of coarse material directly under the impact borehole would plug the borehole when the material had spread to about 100 ft radius. Disposal of finer material into flooded underground workings resulted in a much wider dispersal around the borehole, so that a larger area could be backfilled with fewer holes. It was necessary to pump out the excess water as the workings were backfilled. The economics of refuse disposal are discussed briefly. (LTN)

32605 (CONF-7705111—, pp 22p, Paper 26, Set No. 5) **Need for selective placement of overburden and equipment considerations.** Ralston, D.S.; Wiram, V.P. (AMAX Coal Co., Indianapolis). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Successful surface-mine reclamation is primarily dependent on the operator's success in achieving selective placement of the various overburden materials during mining. Pre-mine evaluation of the soil-burden characteristics should be the tool used in defining both selective placement and related equipment needs. The soil-overburden analyss program (SOAP) at AMAX Coal Company characterizes the overburden materials so that recommendations can be made as to the most desirable agronomic material to place at or near the final surface for use in vegetation establishment. Overburden and/or interburden materials having undesirable physical or chemical properties are identified for burial. As more specialized equipment is developed to meet selective placement requirements of reclamation regulations, the sophistication of the soil-overburden program must keep pace to assure the planning engineer adequate information on which to base his equipment-selection decision for mining a specific coal reserve. If the mining engineer knows the geologic and soil characteristics of the overburden and the applicable reclamation regulations, the proper equipment can be selected to remove the overburden in the most economic manner. The operator plays a major role in whether the equipment works in a certain application. Good communication is especially important where selective placement is needed by a primary excavator. To improve communication of the soap information and reclamation objectives with equipment operators, AMAX is developing video-tape training seminars for use by operations personnel. The need for selective placement has been established by the various reclamation regulations. The most cost-effective method of meeting today's regulations can only be achieved if the soil and overburden characteristics are early inputs into the total planning process for a mine.

32606 (FE—2608-9) **Feasibility study of coal slag based glasses for hot gas clean-up. Monthly progress report No. 9, 1 January 1978—31 January 1978.** (General Electric Co., Philadelphia, Pa. (USA). Space Sciences Lab.). 15 Feb 1978. Contract EF-77-C-01-2608. 7p. Dep. NTIS, PC A02/MF A01.

The hot duct which has been under construction for about 2 months was completed and checked out in both the cold (dry) and hot (wet) (labyrinth only) mode. It performed almost identical to the clear plastic model in that it collected about 91% of the 70% Illinois No. 6 Fly Ash--30% Dolomite mixture while cold (or dry as in the case of the plastic duct). The collection efficiency was about 96% when the duct was operated at 1000°C which clearly indicated that the glassy coating on the collection plates was catching more of the particles. Again the effluent in both hot and cold runs was generally less than 2 micron size particles, although a few big particles have also been found in the exit filters.

32607 (LA—6835-PR) **Trace element characterization of coal wastes. First annual report, July 1, 1975—June 30, 1976.** Wewerka, E.M.; Williams, J.M. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 58p. (EPA—600/7-78-028). Dep. NTIS, PC A04/MF A01.

The literature search on the chemistry and environmental behavior of trace elements in coal cleaning wastes has been completed, and an interpretive report of the findings from the literature has been written. Techniques and methods for analyzing trace elements and minerals in coals and coal cleaning wastes have been developed and are documented in this report. Standard coal and ash samples were used to establish the precision and accuracy of these methods. High-sulfur coal-waste materials have been collected from three coal cleaning plants in the Illinois Basin, and cleaning wastes from a low-sulfur coal have also been collected. Analytical studies of the trace elements and minerals in these wastes are progressing, and investigations of the effects of weathering and leaching on the trace elements in the refuse have been started.

32608 (ORAU/IEA(M)—77-27) **Atmospheric CO_2 consequences of heavy dependence on coal.** Rotty, R.M. (Institute for Energy Analysis, Oak Ridge, Tenn. (USA)). Dec 1977. Contract EY-76-S-05-033. 39p. Dep. NTIS, PC A03/MF A01.

It must be conceded that great uncertainty pervades the estimates of the effect of increased CO_2 concentration in the atmosphere. It is of the highest importance that these uncertainties be resolved as expeditiously as possible, say by 1985. This will require a worldwide commitment of considerable scale. Only such aggressive effort is likely to lead to an estimate of the effect of CO_2 sufficiently robust to warrant the political, social, and economic measures that might be required to deal with unprecedented changes in the world's climate. Increases in the atmospheric concentration of CO_2 cause concern only when the quantities become large--i.e., several hundred billion tons of additional carbon. The direct contribution from emphasis on coal use through 1985, as called for in the U.S. National Energy Plan, is of minor consequence. On the other hand, if such a

policy continues into the next century, or if it serves as a model for major segments of the world, then the quantity of resulting CO_2 could have serious consequences early in the next century. Further, if coal is used on a large scale as the base for liquid and/or gaseous synthetic fuels as the oil and natural gas reserves are depleted, the inefficiencies of conversion would serve to increase the CO_2 produced per unit of delivered energy and further aggravate the problem.

32609 Prevention and underground disposal of extraneous dirt. Turner, C.W. (Natl Coal Board, South Yorkshire Area, Engl). *Min. Eng. (London);* **137**: No. 197, 195-203(Nov 1977).

This article highlights the need to retain dirt produced in the process of coalwinning, either in situ or stowed in the mine wastes. The sources of dirt production underground are identified and methods of controlling the amount of dirt produced from the coal face are discussed. Methods of dealing with dirt from the formation of roadways and the machines available for doing this are examined and the effects of implementation of tried methods are quantified and evaluated. It is recognized that one effect of increased mechanization has been to inflict a severe burden on colliery resources by the increase in the amount of dirt produced. 3 refs.

32610 Automatic water-treatment plant. *Colliery Guardian;* **225**: No. 10, 794-795(Oct 1977).

A continuously operating, nearly automatic water treatment plant at Silverdale Colliery, Newcastle under Lyme, is described. The plant is attended only on the dayshift, and by one man. Both automatic and electric control of the plant are detailed. Fully commissioned since March 1976, the plant has been reducing the iron content of a flow of 2,600 cu m/day (400 gal./min.) of ochreous mine water from some 200 ppM Fe to around 2 ppM and often less.

32611 Separation of oils from wastewaters of the coal-chemical industry by flotation with the aid of cationic surfactants. Sviridov, V.V.; Kokovkina, T.F.; Derbysheva, E.K.; Kagasov, V.M.; Pimenov, I.V. *J. Appl. Chem. USSR (Engl. Transl.);* **50**: 1127-1130(May 1977).

Translated from Zh. Prikl. Khim.; 50: 1168-1171(May 1977).

It was shown experimentally that introduction of small amounts (from 1 to 5 mg/liter) of cationic surfactants into waste waters of the coal-chemical industr intensifies the flotation separation of finely emulsified anthracene nd straw oils.

32612 Measuring technique for waste waters of the coal mining industry helps to protect the living milieu. Saffa, F.; Sen, J.; Borecky, Z. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 287-290(1977). (In Czech).

The problem of the measuring technique for waste waters in the coal mining industry is described using as an example of the Ostrava-Karvina basin. Main sources of waste waters are the mining activity and coal preparation plants. The mining waters of the Ostrava-Karvina basin are characterized by a high salt content, which is the reason for their unsuitability in industry and also presents problems from the point of view of the purity of surface waters. The second part of the article describes particular measuring apparatus and devices for the estimation of the quantitative and qualitative properties of waste waters and, in the conclusion, the article deals with the use of measuring stations for the complex estimation and registration of the monitored parameters.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 32602, 32605, 32607, 32612, 32634, 32650, 32665, 32691, 32975, 32977, 33193, 33683, 33697, 33726, 33739, 33741, 33747, 33933

32613 (BNWL-RAP—21) **Impact of increased coal consumption in the Pacific Northwest.** Burnham, J.B. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EY-76-C-06-1830. 327p. Dep. NTIS, PC A15/MF A01.

The objectives of the National Coal Utilization Assessment are: Identification of the environmental, health and socioeconomic impacts to be expected from the increased use of coal; investigation of mitigation strategies that might be used to manage these impacts; and establishment of working relationships with state and regional agencies and utilities. A number of energy issues were identified in the course of the study. Probably the most significant issues in this region are the siting of coal-fired power plants and the tradeoff in water allocation between energy and agriculture. Choices of coal-fired generation sites and water use determine the level of impacts to air, water, land, terrestrial and aquatic ecosystems, and human health and socioeconomics. Air quality impacts were studied by incorporating current and projected emission inventories into both short-range and long-range air quality diffusion models. Results indicate that annual average ambient air quality standards will not be exceeded at any of the sites. Surface water supplies are more than adequate to meet the needs of new coal-fired generating plants located in the Columbia or Snake River; however, future conflicts could arise with agriculture over allocation of water rights. Water quality impacts would be minimal, even in the delicate estuarine and coastal sites, under the assumed control and cooling designs. Terrestrial ecosystems do not appear to be threatened as long as specific sites are selected to avoid identified areas of "critical" habitat. Impacts on aquatic biota and habitats seem manageable as long as existing regulations are met. Several rare or endangered species are identified. A computer model was used to facilitate the analysis of socioeconomic impacts to be expected from the addition of coal-fired generating capacity at the candidate sites. A number of issues which are still largely unresolved and deserve further attention are mentioned.

32614 (CONF-7705111—, pp 18p, Paper 15, Set No. 3) **Update on overburden characteristics.** Smith, R.M.; Freeman, J.R. (West Virginia Univ., Morgantown). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Reclamation begins with overburden characterization. This means characterization with the eye and with simple field measurements. It means, also, characterization in the laboratory by calibrated physical and chemical measurements. And it means using overburden information in the mining and reclamation operations. This use of overburden information succeeds when operations people appreciate overburden properties. Intelligent use of overburden information from whatever source assures more economical mining and a higher quality package of land after completion. In order to achieve these objectives it is important to judge, sample and determine the right properties consistently. Fifteen properties are described which cover most reclamation problems; a few problems will require more complete information.

32615 (CONF-7705111—, pp 34p, Paper 16, Set No. 3) **Land reclamation and energy conservation.** Howland, J.W. (Reclamation Pittsburg and Midway Coal Mining Co., Shawnee Mission, KS); Goris, J. 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The Specialized Reclamation Field Test jointly sponsored by the Pittsburg and Midway Coal Mining Co. and the United States Bureau of Mines involved the field test and evaluation of a variety of earthmoving tools specifically designed to improve dirt handling efficiency in the reclamation of area mined spoil banks. Early, theoretical approaches, indicated short relocation distances (less than 50 ft.) were associated with the bulk of material handled during the land leveling and shaping process. All the tools constructed and tested under the program were designed to work with improved efficiency in this short distance relocation range. Three prototype angle blades demonstrated average earth moving capacities of some 6000 to 7000 bank cubic yards per hour with maximum production potentials under ideal (castoff) conditions approaching 15,000 BCY per hour. In leveling and shaping normal (90 ft. to 120 ft.) area mined spoil banks, the angle blades moved approximately eighty percent of the material while using some 60 percent of the total tractor time. Conventional bulldozers were used in the final stages of the land shaping process and moved an estimated twenty percent of the total material while using about forty percent of the total tractor time. By comparison with industry standards, cost and tractor time per acre was cut approximately in half, with proportional savings in fuel requirements. The prototype land reclamation tools designed to work with improved efficiency in the short distance relocation range performed quite satisfactorily. This performance confirmed the validity of the theoretical approaches. The basic challenge now confronting the mining industry is to find ways to transfer this new and developing technology from the proving ground to active mines.

32616 (CONF-7710101—6) **Environmental control strategies for coal-fired power plants: a comparative evaluation.** Livengood, C.D.; Farber, P.S.; Wong, S.H. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

An ongoing project has been established at Argonne National Laboratory for the purpose of assessing the implications of environmental control technologies for the coal-to-electricity process from a detailed engineering and cost point of view. In order to place these assessments in the proper perspective, it is helpful to conduct comparative evaluations of their efficacies from a total system viewpoint, taking into account different geographic, environmental, and regulatory constraints. This paper presents some of the results of the initial comparisons carried out by the project. The focus is on control of airborne emissions by presently available technology, as this has been the principal area of investigation thus far. The results point out that there are usually several cost-competitive routes to achieving compliance with existing regulations. However, these routes general-

ly have differing total impacts, particularly offsite, which will become of greater significance as new regulations force lower levels of on-site effluents.

32617 (CONF-7710101—7) **Local socioeconomic impacts of coal development in the midwest.** Baldwin, T.E.; Metzger, J.E.; Stenehjem, E.J. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 10p. Dep. NTIS, PC A02/MF A01.

From 5. national conference on energy and the environment; Cincinnati, OH, USA (31 Oct 1977).

Economic, institutional, and social changes follow the siting, construction, and operation of energy facilities: In host communities lacking sufficient capacity (in terms of infrastructure, housing, labor, etc.) to accommodate the induced growth, a cycle of chronic and self-perpetuating socioeconomic impacts results. In the often-repeated impacts observed in western boom towns, the construction of a coal facility brings with it an immediate demand for labor that induces new households to enter the community. The increased population confronts inadequate public and private services, which reduces the living standards and life styles of all residents and generates rapid labor turnover. This turnover of labor reduces productivity in the energy and service sectors of the local economy, which results in further inadequacies of public and private services, and causes an iteration of the impact cycle. This vicious cycle has been depicted in the regional studies literature as a "problem triangle." Obviously, not all communities that host coal production and/or utilization facilities suffer adverse consequences. To activate the problem triangle, growth must be both rapid and large relative to existing population and employment levels. The lessons of this socioeconomic assessment of regional coal utilization are clear: Many probable sites desirable from the standpoint of water availability, proximity to load centers and/or coal resources and air quality regulations will be found undesirable with respect to their impacts on the people and communities in the host counties relative to alternative county sites. Failure to consider socioeconomic consequences in the siting of coal facilities imposes social costs that, if computed and internalized by the industry, may significantly outweigh the added transport or transmission costs of siting facilities in areas more remote but better able to accommodate new developments.

32618 (PB—272722) **Studies of the pressurized fluidized-bed coal combustion process. Report for Aug 75—Jul 76.** Hoke, R.C.; Bertrand, R.R.; Nutkis, M.S.; Kinzler, D.D.; Ruth, L.A. (Exxon Research and Engineering Co., Linden, N.J. (USA)). Sep 1977. Contracts EPA-68-02-1312;EPA-68-02-1451. 214p. NTIS PC A10/MF A01.

The report gives results of studies of the environmental aspects of the pressurized fluidized-bed coal combustion process, using two experimental facilities: a 218 kg coal/h miniplant continuous combustion/sorbent regeneration system (0.63 MW equivalent), and a 13 kg coal/h batch combustion unit. Combustion studies were conducted to characterize the emissions of SO_2, SO_3, NOx, particulates, and CO from the combustors as a function of combustion conditions.

32619 (WSS/CI—77-48) **Inorganic pollutants from pulverized coal combustion (a review).** Malte, P.C. (Washington State Univ., Pullman (USA). Dept. of Mechanical Engineering). Oct 1977. Contract EX-76-C-01-2252. 26p. (CONF-771015—16). Dep. NTIS, PC A03/MF A01.

From Fall meeting of the Western States Section of the Combustion Institute; Palo Alto, CA, USA (17 Oct 1977).

A review of inorganic pollutants in coal classifies them according to affinity with other major inorganic mineral components (sulfides, sulfates, carbonates, etc.) or affinity with the organic coal. The latter elements are B, Br and Ge and, in some coals, Be, Ga, Sb, Ti, U and V. Most elements have a lower concentration in coal than in the surrounding rocks, but a few are more concentrated in the coal (As, Cl, B, and especially Se). During combustion some of the calcium and other alkali metal compounds appear to tie-up a portion of the sulfur in the coal as sulfates (and thus reduce the air pollution by SO_2), if the combustion temperature is not too high. Fly ash formation is also discussed and the tendency of the more volatile elements (or their compounds) to be concentrated on the submicron particle sizes. Finally, several elements in the ash are recommended for special attention because of possible toxic effects on terrestrial systems, as a result of air pollution or leaching from ash disposal sites. These elements are F, Be, Ni, Cd, Cr(VI), As(III), Hg and Pb, and possibly Tl, Se and Sb. Many of these elements (or their existing compounds) tend to be volatile and to be concentrated on the submicron fly ash particles; mercury and selenium are likely emitted as vapors. Recommendations for further work are given. (LTN)

RESERVES AND EXPLORATION

REFER ALSO TO CITATION(S) 32674, 32685, 33214, 33246

32620 **Model seismic studies of the use of seam transmission waves in prospecting the ground ahead of coal faces.** Dresen, L.; Freystaetter, S.; Sommer, H. (Dtsch Forschungsgem, Ger). *Glueckauf-Forschungsh.;* **38**: No. 5, 177-182(Oct 1977). (In German).

The sonic transmission method with seam waves constitutes a possibility of detecting faults in prospecting the ground ahead of coal faces. If this method is used by itself for such prospecting, it is necessary to determine the minimum dislocation heights at which faults in the seam can be detected. In order to determine these heights for the case of simple geological occurrence relations, model-seismic studies were carried out on models of faulted and unfaulted seams with dislocation heights up to three times the seam thickness. It was found that essentially two mechanisms are responsible for the passage of seam waves at a fault from the undislocated (source-containing) part of the seam to the dislocated part (source-free). 19 refs.

32621 **Actual state and prospects for a material and energetic utilization of fossil energy carriers, especially of lignite in the German Democratic Republic.** Grossmann, P.; Keil, G.; Schymalla, A. (Akademie der Wissenschaften der DDR, Berlin). *Koks, Smola, Gaz;* **22**: No. 10, 267-270(Oct 1977). (In Polish).

The actual state of reserves and the utilization of fossil energy carriers, especially of lignite, is discussed. Possibilities are given of the utilization of lignite in materials and energy management.

32622 **Assessment of hydrogeological mining conditions in the Sibovac mining field of the Kosovo Coal Basin.** Pifat, M. (Rud Inst, Begrade, Yugosl). *Rud. Glas.;* No. 3, 29-36(1977). (In Serbo-Croatian).

The Sibovac lignite deposit is located in the northern part of the Kosovo Coal Basin in Yugoslavia. Hydrogeological and geomechanical data obtained from the investigations carried out in the coalfield during the 1974-75 period are presented. These data give general insight into the mining conditions, mine design, drainage, bench stability and technical mining problems during the initial mining stage. A single coal seam is being developed in the Sibovac lignite deposit.

MINING

REFER ALSO TO CITATION(S) 32604, 32605, 32609, 32610, 32615, 32617, 32694, 32695, 32708, 32710, 33246

32623 (CONF-7705111—) **American Mining Congress 1977 coal convention.** (American Mining Congress, Washington, D.C.). 1977. 426p. Mining Congress.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

The 1977 Coal Convention of the American Mining Congress was held at Pittsburgh, Pa., May 1 to 4, 1977. Forty papers have been entered individually into EDB and ERA and four also into EAPA. The papers cover the energy crisis, US plans for increased coal production, mining equipment. dust suppression, noise control, improved face ventilation, land reclamation after surface mining, waste disposal, coal preparation (including comparative evaluation of 6 chemical coal cleaning processes), optimization of unit train operation for coal transport, surface mining (computer simulation and planning), conveyors, mining methods (longwall, shortwall and room-and-pillar), productivity, management, coal mine research programs, lighting systems, ventilation, in-mine transport of coal and people, experience with tunnel boring machines, stabilization of pillars, fire extinguishment at the Olga coal mine, and reentry operations at the Scotia mine after 2 explosions and sealing. (LTN)

32624 (CONF-7705111—, pp 7p, Paper 2, Set No. 1) **Interior Department's initiatives to increase coal production.** Andrus, C.D. (Secretary of the Interior, Washington, DC). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The present policy of the U.S. government as represented by the Department of the Interior is to increase the annual production of coal by 400 million tons (a 60% increase) by 1985. This increased production of coal and an increased conservation effort is a response to developing shortages of oil and natural gas. This increased production of coal is to be attained in spite of new standards of land reclamation and environmental protection. At the time of the conference the Federal coal leasing program was being reviewed. Among other things the proposed Department of Energy will take over some leasing functions now under the Department of the Interior. (LTN)

32625 (CONF-7705111—, pp 8p, Paper 5, Set No. 2) **Ideas for canopies on low coal equipment.** Korber, E.J. (Bethlehem Mines Corp., Ebensburg, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Experience in the design and operation of protective canopies on underground mining equipment is reported. Remotely controlled equipment and closed circuit television on this equipment are also being experimented with. (LTN)

32626 (CONF-7705111—, pp 8p, Paper 6, Set No. 2) **Ideas for canopies on low coal equipment.** Fornari, J.M. (Rochester and Pittsburgh Coal Co., Indiana, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Canopies for mining equipment operating in seams of 36 to 48 inches are described. Lower profile equipment operated by remote control may be the ultimate answer. (LTN)

32627 (CONF-7705111—, pp 26p, Paper 7, Set No. 2) **Developments in underground surveillance instrumentation.** Strange, J.P.; Marshall, H.H. Jr. (Mine Safety Appliances Co., Pittsburgh). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Early instruments for monitoring methane in coal mines required considerable attention and maintenance to keep them in operation. The development of a sensor consisting of a platinum filament imbedded in a ceramic impregnated with a catalyst provided a longer life filament and with much less zero drift in its operation. The Coal Mine Health and Safety Act of 1969 provided the impetus for the development of systems for complete mine monitoring on a continuous basis. The development of microelectronic components, mini computers, multiplexers and alarm systems has made it possible to design systems providing remote monitoring (and communications) at many points with the data continuously recorded at a central area. Portable devices are also described. (LTN)

32628 (CONF-7705111—, pp 21p, Paper 8, Set No. 2) **Scotia mine recovery operation.** Cornett, J.K. (Blue Diamond Coal Co., Knoxville, TN). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

After explosions on March 9 and 11, 1976, the Scotia mine at Owen Fork, Kentucky, was sealed due to hazards from possible fires and further explosions. After 4 months, during which the methane concentration rose to 42 percent, the mine was gradually reopened by sealing off a section under apparatus, ventilating that section and then proceeding to the next section. The recovery operation was completed almost 1 year later. Various precautions, problems encountered, roof and other repair work necessary are discussed in detail. It was found that rock dusting had been effective in limiting the two explosions which occurred initially. A considerable amount of rock dusting was necessary in the areas of the explosions after the mine was reentered. (LTN)

32629 (CONF-7705111—, pp 13p, Paper 9, Set No. 2) **Equipment modification for improved face ventilation.** Greene, P. (Joy Manufacturing Co., Franklin, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

In most modern mining systems face ventilation exceeds the minimum requirements for fresh air to the men. The current problems surrounding face ventilation usually center on two needs which are not always fulfilled as well as they might be. These are dust control and methane dilution. Both dust and methane present an explosive danger, and of course the black lung problem from dust exposure is well understood by anyone associated with the coal industry. The discussion relates to these two problems and possible ways to alleviate them in mining systems using a continuous miner.

32630 (CONF-7705111—, pp 7p, Paper 10, Set No. 2) **Equipment modification for improved face ventilation.** Pickard, W.J. (Dresser Industries, Inc., Columbus, OH). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Methods of improving ventilation at the working face of a coal mine are discussed. These include brattice cloth curtains maintained 10 ft from the face and machine-mounted diffusers to promote mixing at the face. Dusts are controlled by sprays or by collecting the dusty air and passing it through a scrubber. (LTN)

32631 (CONF-7705111—, pp 27p, Paper 11, Set No. 2) **Equipment modification for improved face ventilation.** du Toit, P.J.G. (Ingersoll Rand Co., Pittsburgh). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

One of the primary purposes of any coal mine ventilation system is to dilute and remove methane and dust generated by the mining process. This is accomplished by a ventilation system composed of two subsystems: the primary or main ventilation system and the face ventilation system. The present Federal regulations Title 30, CFR, Part 75.301, states that the primary ventilation system must provide a minimum of 9,000 cubic feet of air per minute at the last open crosscut. The face ventilation system utilizes the air at the last open crosscut to sweep the working face with a minimum of 3,000 cfm to dilute and remove methane and dust generated by the mining process. With simple exhaust curtain or tubing systems only one-fourth of the air present in the face return is actually used to dilute methane in the bit area. Consequently, in some cases additional face ventilation systems should be used to provide the necessary air quantity and velocity to dilute and remove methane and respirable dust generated at the face by the mining process. Secondary ventilation, where dusty air is drawn or "vacuumed" from the vicinity of the face and then either discharged into the return via a duct or passed through a machine-mounted dust collector with the effluent air discharged at the mining machine, has proved to be a very powerful dust control technique. With room-and-pillar mining drawing about one-half of the incoming main ventilating air from the front end of the mining machine through simple air intakes should lead to a 90 percent reduction of the respirable dust levels at typical personnel locations. Field underground tests with one mining machine, a Wilcox Mark 20 auger, have confirmed these results when the intake dust levels are taken into account. Further reductions in dust produced have been achieved by the design and operation of the cutting bits and by the use of extensive water sprays around the bits.

32632 (CONF-7705111—, pp 26p, Paper 12, Set No. 2) **Face ventilation for an automated extraction system.** Freed, D.L. Jr. (National Mine Service Co., Nashville). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Basic design features, details of the face ventilation system, and in-mine evaluation plans are presented for an Automated Extraction System (AES) that has been designed to fill needs which are present in the Mining Industry. The philosophy of design and proposed operation of the machine, as well as the relationships between these factors, are reviewed. The AES is designed to overcome production problems resulting from the regulation of roof control, clean-up, ventilation, dust suppression, and operator protection required by the Federal Coal Mine Health and Safety Act of 1969. The design permits more continuous operation and greatly improves operator safety. The machine is a full-face drum-type continuous miner which includes self-advancing, continuous temporary roof support. Onboard self-advancing face ventilation, dust suppression, and air scrubbing equipment are also included in the design. A further improvement over existing equipment is the incorporation of an automatic programmed cutting cycle control system. All mining functions including movements of the roof support system are handled by this automatic system.

32633 (CONF-7705111—, pp 45p, Paper 13, Set No. 2) **Noise control of an underground continuous miner, auger-type.** Giardino, D.A.; Bobick, T.G.; Marraccini, L.C. (Dept. of the Interior, Pittsburgh). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

This report describes the noise control modifications made on a Wilcox Mark 20 underground coal auger miner and related bridge conveyor. The reported reduction in operator noise level is 10 dBA as measured with the equipment operating unloaded at the MESA test facility. Underground noise surveys conducted over a 1-year interval showed the noise level at the operator's position to be 97 dBA, a reduction of 5 dBA from the before modification noise level of 102 dBA.

32634 (CONF-7705111—, pp 24p, Paper 23, Set No. 4) **Planning of a new surface mine: western coal.** Graham, R.J. (Consolidation Coal Co., Englewood, CO). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The following items are discussed: coal deposit exploration, preparation of environmental impact statements, permits and licences needed, equipment selection (based on planned mine size and exploration findings), materials handing of the coal, coal preparation (sulfur content is low but thermal drying and oil treatment will improve coal quality, lower transportation costs, improve burning quality, and reduce boiler operation and maintenance costs), coal storage, and socio-economic factors. (LTN)

32635 (CONF-7705111—, pp 25p, Paper 25, Set No. 5) **Economics of large-scale surface coal mining.** Boyce, T.A. (Fluor Utah, Inc., San Mateo, CA); Draffin, C.W. 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Realizing that large-scale surface coal mines would be needed to supply feedstocks for conversion processes currently under development, the U.S. Energy Research and Development Administration sponsored this project to be better able to: estimate expected costs of mining and processing coal; and provide industry with planning and analysis models to facilitate mine design and equipment selection to meet future increased production needs. The project resulted in the development, testing, and documentation of simulation models which can rapidly and inexpensively: Estimate capital investment and annual operating cost for a surface coal mining project; select equipment and estimate unit costs for each individual mining function. Estimate manpower, materials, and infrastructure requirements for the project; and analyze coal selling price and profit relationships. All coal mining and processing functions are included in the modeling system: Overburden drilling and blasting, overburden removal, coal drilling and blasting, coal loading and hauling, coal handling and processing, land reclamation, premining, facilities, and administrative costs, and economic cash flow analysis.

32636 (CONF-7705111—, pp 9p, Paper 27, Set No. 5) **Control of vibration and noise resulting from surface mine blasting.** Kerulis, F.J. (NUS Corp., Charlston, WV). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

In many instances the public has an inherently negative opinion of surface mining. This opinion is often reinforced by mistaken interpretation of the damaging effects of equipment noise and blasting vibrations. In most cases vibrations caused by blasting are negligibie, the only significant sensation being from noise. Seismic records have shown that such noise is incapable of causing structural damage. Additional investigations have shown that there is a wide variation in individual noise reactions and that no apparent relationship exists between the size of a blast and the number of complaints. Most mining states have regulations governing the use of explosives in surface mining. These regulations vary from minimal regulations to strict control of the amount of explosive used and the distance to the nearest dwelling. In most cases these laws pertain to vibration control directly and noise control indirectly. A good many of these regulations are based upon studies conducted by the U.S. Bureau of Mines as presented in Bulletin 656, "Blasting Vibrations And Their Effects On Structures".

32637 (CONF-7705111—, pp 20p, Paper 28, Set No. 5) **Cross pit conveyor systems.** Frizzell, E.M. (Bureau of Mines, Spokane, WA); Martin, J. 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

A great deal of attention is presently being given to the utilization of the Western coal reserves and their potential for surface mining. The geology of the region and the orientation of the seams present no new problems. The coal seams are thicker (5 feet to 120 feet), the overburden depths are greater (maximum of 200 feet to 300 feet, planned for a number of mines), and the mines will be larger. Deeper surface mining is not only dictated by economics, but also by our growing desire for full recovery of our resources once we have disturbed the surface. The economic utilization of this lower BTU coal, coupled with its higher freight costs, necessitates high production volumes. These reserves pose new excavating and material handling requirements that deserve special consideration. This coal from the west must also be produced while complying with high reclamation standards and their related cost. To minimize costs the mining techniques must integrate these requirements into the operations and not leave them as an "add on". Coping with the anticipated higher volumes is a challenge with respect to both overburden and coal. The most proven, cost effective, volume excavating approach to date has been dragline. The most proven, cost effective, continuous, volume transport approach to date has been the belt conveyor. Can these be mated to provide a less intermittent system.

32638 (CONF-7705111—, pp 14p, Paper 29, Set No. 6) **Comparison of longwall-shield, chock, and frame supports.** Irresberger, H. (Bergbau Forschung GmbH, Essen). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

A comparison of various types of support available for use in longwall mining leads to guidelines which may be useful in choosing the type most suitable for any individual application. (LTN)

32639 (CONF-7705111—, pp 9p, Paper 30, Set No. 6) **Shortwall mining at Helen Mining Company.** Fraicola, G. (Helen Mining Co., Homer City, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The Helen Mining Company in 1977 finds itself somewhat unintentionally, but happily, engaged in shortwall mining of low seam coal--a little unusual today but holding great promise for tomorrow. Shortwall may not be the answer to everyone's pressures for increased productivity, but it probably offers efficiencies and economics in many operating situations. If our in-hand continuous miner and radio remote performance capabilities could somehow be matched by a continuous haulage system that would "really let the miner go" along a shortwall face, we would see some bottom-line figures that would assure shortwall methods a prominent place in the years ahead. It is a privilege for us to provide the industry's most interesting testing grounds for shortwall mining.

32640 (CONF-7705111—, pp 7p, Paper 31, Set No. 6) **Mining through abandoned oil and gas wells.** Pasini, J. III; Rennick, G.E. (Morgantown Energy Research Center, WV). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The plugging and safe mining into and through wells intersecting deep minable coalbeds has been successfully demonstrated and with modifications the demonstrated techniques can be applied to all nonproductive wells. It is doubtful that techniques will ever be developed to allow temporary plugging, mining through, and recompletion in the case of productive wells in deep mining operations. However, this must be considered as a real possibility in the case of surface mining, especially for the thick coalbeds of Wyoming. The present plugging techniques used in the various states, where extensive mining is being carried out or projected, should be reviewed to determine if the plugging is adequate to allow safe mining into and through the wells plugged since the new laws were implemented. In these cases it will be necessary to clean out the wells to the lowest minable coalbed and determine if gas is leaking into the wellbore.

32641 (CONF-7705111—, pp 17p, Paper 32, Set No. 7) **Improving coal mine productivity.** Straton, J.W. (Gates Engineering Co., Beckley, WV). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Mine Management has a strong role to play. Regardless of the obstacles put in its path, it must use every possible means at its disposal to meet the country's energy needs in a manner which is consistent with the realistic requirements of the people. Management can and must create and maintain a safe, efficiently producing industry which can fulfill the needs of society. Coal industry leaders are called upon to supply ideas, encouragement and funds for research in areas of machinery, mining methods, safety and labor relations. Management needs to put its engineers back at the face to develop methods which will minimize the production loss resulting from compliance with regulations. Find more Available Production Minutes and make those minutes more productive. Devise a section management plan which will make it possible for the Section Foreman to become again a production manager. It is highly probable that implementation of these suggestions will result in safety and productivity improvements, the benefits of which will substantially exceed the costs.

32642 (CONF-7705111—, pp 18p, Paper 33, Set No. 7) **Review of coal mining research.** Yancik, J.J. (National Coal Association, Washington, DC). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The coal mining research programs of the U.S. Bureau of mines are reviewed in considerable detail. (LTN)

32643 (CONF-7705111—, pp 15p, Paper 34, Set No. 8) **Bureau of Mines research program on mine illumination.** Bockosh, G.R. (Pittsburgh Mining and Safety Research Center). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The Federal Coal Mine Health and Safety Act of 1969 provided for the formulation of illumination standards for underground coal mines which were promulgated on October 1, 1976. The Bureau's program of research on mine illumination, which has evolved supportive data for standards and the technology necessary for their implementation, is presently directed toward demonstrating cost effective and reliable means to provide underground illumination; providing the technological means by which these standards can be expeditiously realized; and insuring that the industry is aware

of existing hardware and also possesses the expertise needed to apply it efficiently. The realization of a thouroughly informed industry and the existence of readily available, mineworthy hardware will enable the implementation of the standards to progress in a reasonable manner. The current work of the Bureau of Mines on mine illumination is herein described.

32644 (CONF-7705111—, pp 21p,Paper 35, Set No. 8) **Results of installation of underground mine lighting systems.** Vines, R.L. (Bituminous Coal Operators Association, Washington, DC). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Based on the findings and conclusions of the Joint Committee reached during its investigation of problems associated with the current state of development of technology for illumination of coal mine working places, the Joint Committee makes the following recommendations, which are interrelated, and should not be considered separately, and are for the purpose of devising standards for improving the working environment of coal miners by use of adequate levels and quality of lighting. The Mining Enforcement and Safety Administration, in consultation with the mine operators and the miners and their representatives should give most serious and immediate consideration to the following steps: (1) Consideration of limiting the use of high intensity lights so as not to be directed toward the normal work area of a miner. (2) Consideration of restating the light level specifications in terms other than reflected light, and restating the specifications for distribution of light, so as to require lighting which is feasible of attainment in a manner which does not produce glare problems for miners.

32645 (CONF-7705111—, pp 14p, Paper 36, Set No. 8) **Effects of weather on mine ventilation.** Bruzewski, R.F.; Aughenbaugh, N.B. (Univ. of Missouri, Rolla). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Air temperature, air pressure and humidity measurements were monitored at the mine surface and at various points underground. In the winter the ventilating air was warmed as it moved within the mine and the reverse occurred in summer. Similar daily variations occurred. Humidity variations in the input air fluctuate considerably with the seasons, but that of the output air is comparatively stable. (LTN)

32646 (CONF-7705111—, pp 47p, Paper 37, Set No. 8) **Rubber-tired haulage versus rail haulage as a service function.** Dwosh, D.M. (Inland Steel Co., Sesser, IL). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The final results of this economic analysis indicate a positive cost advantage of rubber tired haulage over track haulage in both single and double mains systems and at haulage distances to at least thirty thousand feet. Although this advantage was not anticipated by either the mine management or by the preparers of this study, the explanation of this phenomena does appear to be logical. First, the cost of rail equipment averages thirty percent more than trackless equipment. Second, the cost of uninstalled track material per mile is equivalent to the cost of a tractor and batteries. Labor, the third cost area, does not begin to be an advantage to the track system until a distance of ten thousand feet of haulage is required in the single system and twenty thousand feet in the double system. The comparative cost of the systems is paradoxical because a hundred thousand dollar advantage of one system over another is important, but if ten million tons will be mined in the cost savings period, that saving will only be one cent per ton. Thus, economy cannot be the sole criteria in the selection of a transportation system. Natural conditions for instance, may determine the system without the need for an economic study. Rubber tired haulage will not work in a mine with very wet, soft bottoms, and track will not work where long steep grades will be encountered. Other factors that may influence the decision are availability of capital, availability of trained workmen and supervisors, the size and configuration of the mine, and even operating management's attitude toward the systems. Rubber tired haulage is now a viable and economic method of transporting men and supplies. Battery tractors, the work horse of this system, have been available for many years, but the new generation of self-propelled, rubber tired mantrips has made this alternative a reality.

32647 (CONF-7705111—, pp 9p, Paper 38, Set No. 9) **Boring a coal mine slope.** Bullers, W.E. (Rochester and Pittsburgh Coal Co., Indiana, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Experience in driving two tunnels (2443 ft and 936 ft) with a Jarva Mark 12 tunnel boring machine is reported. The equipment operated very satisfactorily, but may not be suitable if considerable amounts of water are encountered or with certain rock strata which may tend to plug the muck buckets. In the cases considered the cost was 30 percent of equivalent tunnels constructed by conventional methods and was about 2½ times faster. (LTN)

32648 (CONF-7705111—, pp 28p, Paper 39, Set No. 9) **Olga mine fire.** Stone, C.B. Jr. (Lykes Resources, Inc., Murray, PA); Valeri, M.; Hickam, H.H.; Denton, G.H. 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The cause of the fire in Olga's 5 West section could not be directly determined. We are not likely to ever know with certainty what caused the fire. When a mine fire occurs, many factors must be considered in determining methods to extinguish and/or fight the fire. Once the health and safety of the men are assured, then the preservation of the mining equipment and the mine itself is paramount and factors such as the nature, extent, and location of the fire are important in the decision making. Mine sealing and/or flooding are the generally accepted methods to extinguish a mine fire. At Olga, sealing of the 5 West area was almost impossible and flooding could not be attained because of the nature of the coal structure and lack of access to construct dams. In the opinion of Olga and Lykes Resources, the use of foam and fly ash and rock dust slurry in vertical bore holes to the fire area, while not completely extinguishing the fire, prevented its spread to other areas of the mine. To our knowledge, the industry has not previously utilized foam with such high strength or in such large volumes. The foam treatment was expensive, $2,500,000 of direct costs, but it worked, and in a relatively short period of time.

32649 (CONF-7705111—, pp 13p, Paper 40, Set No. 9) **RIB stabilization using steel pillar banding.** Baumgarth, T.P. (U.S. Steel Corp., Gary, WV). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Rib support was originally by roof bolts installed horizontally on 4 ft centers with bearing boards. This procedure was not completely effective. Sloughing of the coal ribs leaves a weak shale roof overhang, which represents an extreme hazard after a little weathering. Further, sloughing of the ribs widens the entries and some roof falls have occurred later. Now, steel strapping (2 in. wide and 0.044 to 0.065 in. thick) is used to hold boards or 4 x 4 in. wire mesh screen against the rib covered with gunite. Methods of tensioning and fastening the steel strapping are described. Another use of the steel strapping is for supplementing roof control. (LTN)

32650 **Rheinbraun preserves environment.** *World Min.;* **30**: No. 12, 53(Nov 1977).

In the fall of 1978 stripping will start at what will become the largest open pit mine in the world. The Hambach pit of Rheinische Braunkohlenwerke AG will reach its full production rate by 1995 when 50,000,000 annual metric tons of brown coal will be mined. This mine is in the heart of the Rhineland. The approval of the decision to develop the Hambach pit was only granted after intensive investigations and studies. A much larger number of original forest areas is now to remain undisturbed. These will act as nuclei for natural regeneration and also as screens and buffers shielding the mining areas.

32651 **Advanced technology mining.** Bourne, W.J.W. (Coalface Min Oper, Natl Coal Board). *Min. Eng. (London);* **137**: No. 197, 187-194(Nov 1977).

In 1974 the U.K.'s National Coal Board announced its intention to proceed with a program of Advanced Technology Mining to follow on from the mechanization initiative first launched in the 1950s. The intention is to promote the wider use of recent coalface techniques which will enable the industry to achieve substantially better levels of performance and which will have a substantial potential for remote and, ultimately, automatic control. The program embraces elements of modern coal mining practice, which when more widely established will be incorporated into integrated longwall face-designs. This article examines the ideas involved in Advanced Technology Mining and considers how the industry can benefit from them. 7 refs.

32652 **Things left undone: presidential address to Southern Counties Branch of Imine.** Dudley, N. *Min. Eng. (London);* **137**: No. 197, 205-214(Nov 1977).

The author draws largely on his own personal experience as a mining engineer to point out certain specific areas of mining activity in which his work was left unfinished or was only partly successful. These areas include the design of locked-coil winding ropes and winder drives of winders or hoists, mechanical handling and underground transport of coal, refuse handling and metal recovery at an iron mine, and energy conservation in mines. 10 refs.

32653 Opencast coal mining in the United Kingdom and its role in the mining industry. Davidson, D.J. (Natl Coal Board, Engl). *Min. Eng. (London);* **137**: No. 197, 215-221(Nov 1977).

The author examines the trends in opencast coal mining in the U.K. and shows how the whole concept of opencast mining in that country has radically changed over the past 30 years. The future availability of opencast reserves in Great Britain is also discussed in terms of both technically workable and economically workable deposits. Finally, a brief description of the production techniques employed in opencast mining is given.

32654 European coal toward the year 2000. (Com d'Etud des Prod de Charbon d'Eur Occident). *Ind. Miner. (St.-Etienne, Fr.);* **59**: No. 11, 525-528(Nov 1977). (In French).

Under the energy policy adopted by the Community in 1974, coal production is scheduled to be maintained at the same level until 1985. After that year, coal output in the European Community is planned to gradually increase to 290-340 million tons by the year 2000. These and other coal plans mapped out by the West European Coal Producers Study Group (CEPCEO) are discussed in the light of the long-term energy situation both in the world and the European Economic Community. End-uses of coal in the Community are also reviewed, and the capability of the Community's coal industry to meet increased demand is analyzed.

32655 Lignite: open-cast mining reaches new heights. Tilmann, W. *Ind. Miner. (St.-Etienne, Fr.);* **59**: No. 11, 537-542(Nov 1977). (In French).

Lignite production in the European Community rose from 128.7 million tons in 1975 to 139.6 million tons in 1976m, most of it used to supply power plants. The gain in production was made in many coal basins by expanded open-cast mining operations coupled with the opening of new deposits. The author reviews lignite production in the Community by single producing countries, with particular reference to West Germany where lignite accounts for 10% of the total primary energy usage, and where bucket-wheel/belt excavators with 200,000 tons/day capacity are in use.

32656 Non-blunting tool for cutting coal and rock. Kenny, P.; Johnson, S.N. (Natl Coal Board, Min Res and Dev Establ, Engl). *Colliery Guardian;* **225**: No. 10, 760, 762-763(Oct 1977).

Investigations of wear of coal and rock cutting tools have led to the development of a non-blunting tool. This tool has a tip consisting of two layers: a thin hard front layer on the rake face of the tip is backed by a thicker softer layer. Current work aimed at the preparation of robust versions of the non-blunting tool suitable for underground use is briefly reviewed. The expected benefits of the new tool in underground use are reductions in the stressing of machine components and increases in tool life. 13 refs.

32657 Thoresby colliery: entry into the Parkgate Seam. Wheatley, T.E. (Thoresby Colliery). *Colliery Guardian;* **225**: No. 10, 769-782(Oct 1977).

First part of this article deals with the development of the Parkgate Seam at Thoresby Colliery in the U.K. Situated about 9 miles from the town of Mansfield, this pit produces over 1.25 million tons annually. Both underground and surface transport of coal, materials and manpower is described, and the preparation of access roads, ventilation drifts and shafts is detailed. The methods of drilling are also covered.

32658 Fire resistant hydraulic fluids: their application in British mines. Myers, M.B. (Century Oils Ltd). *Colliery Guardian;* **225**: No. 10, 796, 799-802, 804-808(Oct 1977).

The application of fire resistant hydraulic fluids within the British mining industry is described. The author defines the fire resistant fluids, reviews main fire resistance tests, and then discusses four categories of these fluids: oil-in-water emulsions, water-in-oil emulsions, water glycol fluids, and anhydrous or non-water containing synthetic fluids. 8 refs.

32659 Sorption behavior of carboniferous rocks and certain materials used for mine supports. Kargar, S.; Bocksch, G. (Tech Univ, Berlin, Ger). *Glueckauf-Forschungsh.;* **38**: No. 5, 183-191(Oct 1977). (In German).

The sorption isotherms of rock samples taken from mines in various coal mining districts in West Germany were determined gravimetrically. The results obtained lead to the conclusion that sorption phenomena of the magnitude determined clearly affect the mine climate and that carboniferous rocks, owing to their sorption behavior, can cause a considerable change in the mine climate. These results demonstrate a possibility of quantitatively predicting the water vapor sorption behavior of the rock and of materials widely used for mine supports. 12 refs.

32660 First operational experience with the class 200,000 bucket wheel excavators at the Fortuna opencast mine. Brumme, B.; Deindl, R.; Loegters, C. *Braunkohle;* **29**: No. 9, 349-355(Sep 1977). (In German).

After one years' operational experience at the Fortuna opencast mine this contribution reports on the opencast experience gained in the use of the class 200,000 bucket wheel excavators. Presented is the experience gained in the transportation from the building site over a distance of 6.1 km to the application site. This bucket wheel excavator is employed for the clearance of overburden and coal in block operation. Together with the class 100,000 bucket wheel excavators at the Fortuna opencast mine this large scale equipment is employed for high and deep level cutting with a total clearance thickness of 60 to 70 m. The capacity is viewed from the following aspects: 1) The capacity of the bucket wheel, 2) the conveying chain, within which the excavator forms part of a number of systems, 3) the material and 4) the application conditions from a mining point of view. Finally, the trends in the mechanical and electrical maintenance of this large scale equipment are discussed.

32661 Electrotechnical equipment of the Fortuna opencast mine. Haneklaus, E.; Lueg, U. *Braunkohle;* **29**: No. 9, 380-385(Sep 1977). (In German).

From the entire complex of brown coal mining, those specialized fields of electrotechnology are described which have contributed considerably in giving the Fortuna opencast mine its present state. In this respect, attempts have been made to show the development trends in power distribution and drive technology in the course of the past two decades and to evaluate these on the basis of the experience gained in operation.

32662 New terrestrial surveying process in the 'Fortuna' opencast mine involving optimal use of data processing equipment. Rosenbach, H. *Braunkohle;* **29**: No. 9, 385-389(Sep 1977). (In German).

The field of activity of a mine's survey section is described, based on the example of the 'Fortuna' opencast mine belonging to the Rheinische Braunkohlenwerke AG. The development of surveying techniques in the last 25 years is alluded to, with reference to the specialist literature. The course of the surveying technique using the AGA 710 electronic laser tachymeter and the further processing are presented with the help of graphic illustrations. In this connection the necessity of smooth communication between surveying and further data processing is referred to. The demand for constantly up-to-date opencast mining position reports and the difficulties with organization and communication in the use of big central computers have recently led to new considerations. In cooperation with the main computing center and jointly with the help of medium-sized locally situated computing and plotting installations. The hitherto prevailing survey period would be adequate here for the mass survey calculation to be based on this as a comparison or check calculation. Whether the measuring is carried out terrestrially or photogrammetrically as the basis for further planning and survey processing must be decided in each case with one consideration to the local situation, the operational timetable and the required precision.

32663 Technical equipment at the Fortuna opencast mine. Schweins, B.; Henatsch, P. *Braunkohle;* **29**: No. 9, 343-348(Sep 1977). (In German).

This article provides a brief preview of the development of the technical equipment and the operation of the plant at the Fortuna opencast mine from 1955 to the present day. Gone into are the special types of bucket wheel excavators, spreaders and conveyor belt installations and the capacities of this equipment in relation to the annual outputs. The new design of belt drives for the Class 200,000 equipment is discussed as well as the multi-motor drives and the 2-way gearboxes. Listed are also the measures for improving the conveying plants as well as the results of many of the tests which have been made during the 22 years of operation of the Fortuna opencast mine or are being conducted at present.

32664 Organization and monitoring of the working sequence in the Fortuna opencast mine. Henning, D.; Schneck, H. *Braunkohle;* **29**: No. 9, 363-369(Sep 1977). (In German).

The working sequence in the Fortuna opencast mine is the result of numerous decisions and activities in interaction with environmental influences and disturbance variables within the company. Demonstrated are the most important organizational structures and measures with which the company is run, planned and controlled. A central unit for carrying out control and monitoring measures in the working sequence is the operation monitoring system, the functions and modes of operation of which are explained.

32665 Optimum Colliery takes lead with open cast restoration. *S. Afr. Min. Eng. J.;* **88**: No. 4132, 26-27, 31, 81(Sep 1977).

Optimum Colliery was the first large-scale strip mine to start operating in South Africa. By the completion of the program more than 100 000 trees will have been planted. In addition grasses and other vegetation are being planted where possible.

32666 Hydrostatic drives finding new applications in mining industry. Morton, J. (Hytec, Transvaal Pyt, S Afr). *S. Afr. Min. Eng. J.;* **88**: No. 4132, 103, 105-107(Sep 1977).

The basic principles involved in hydrostatic transmissions is that the hydraulic pump coupled to the prime mover is the means of converting mechanical energy into fluid energy, where the volume of oil gives the speed and the pressure gives the torque of the transmission. This fluid energy is then transferred through pipework to the hydraulic motors which convert fluid energy. This article offers advantages and disadvantages for hydrostatic transmission with details of some of the new developments in this field.

32667 Calculation of the stability of opencast slopes on an electronic computer with the BETAJA programme. Dermietzel, E.; Metzmacher, H.; Pierschke, K.J. *Braunkohle;* **29**: No. 8, 309-315(Aug 1977). (In German).

One modular structure of the EDP programme 'BETAJA' makes for simple programme care. The necessary supplementations in the different sections of the programme according to the respective actual knowledge can be carried out without any difficulty because they do not effect the other routines. This means to say that programme care is easy. A control variable (directional switch) makes it possible to maintain different outputs without direct intervention in the programme. All data fed to the programme or processes by same can be presented graphically and/or analytically at any time and, as a consequence be checked easily and quickly. In the case of repeat calculations only the data of the new slope polygons and the new slip line need be fed into the computer. The time-consuming and error susceptible measuring of new hanging line sections by hand is eliminated because the remaining geology is determined by the programme. The new software and the use of modern hardware (Digitizer, UNIVAC 1110 and Plotter 936) reduces the processing time per section to a fraction of that required previously. The data as criteria for decision making in work planning can be made available significantly quicker than hitherto.

32668 Stability of bucket wheel excavator slopes. Henning, D. *Braunkohle;* **29**: No. 8, 303-309(Aug 1977). (In German).

With the chronological change in the slope geometry in the case of bulk clearance with bucket wheel excavators there is also a change in the stability of the slope. Measures to improve the slope stability must aim at increasing the holding forces or reducing the shifting forces. The structure and properties of the formation and the effects of water are not influencable to a wide degree by the nominal values which have leading influence on the slope stability. An improvement in the slope stability can be achieved by suitable correlation of slope height, angle, length and age and the loads carried by same as well as the selection of the direction of working on the pregiven influencing factors.

32669 Laboratory mechanical strength tests on prejointed specimens made of cohesive loose rock. Natau, O. (Karlsruhe Univ. (TH) (Germany, F.R.). Inst. fuer Bodenmechanik und Felsmechanik); Schmidt, M.W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tieflagerung). *Braunkohle;* **29**: No. 8, 321-324(Aug 1977). (In German).

Mechanical strength tests were carried out and interpreted according to the Karman principle using cylinder specimens made of homogenized kaolin provided with defined parting surfaces.

32670 Construction of statically admissible fields of tension in embanked granulate materials. Zimmermann, B. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Technische Mechanik). *Braunkohle;* **29**: No. 8, 300-302(Aug 1977). (In German).

The determination of statically admissible fields of tension in embanked granulates amounts to the solving of a plane tension problem. The occurring DLG system is treated according to the characteristic method. Here parabolic behavior can occur on the boundary. In this case the slope can be given explicitly.

32671 Optimising problem in mine planning. Chakravarty, J.L.; Sinha, D.K. (Bengal Eng Coll, Calcutta Univ, Howrah, India). *J. Mines, Met. Fuels;* **25**: No. 6, 161-165(Jun 1977).

The authors examine the problems of coal mine planning in India, and outline a general production planning procedure which involves the following four steps: (1) Selection of the most economically expedient plan for development of industry as a whole (2) Selection of the most economic plan of development of coal-fields, coal basins, divisions, areas, etc.; (3) Selection of the economically expedient parameters for building new mines in a given coalfield or revamping existing mines; and (4) Determining the economic scope of development work in individual mining areas or mines, and mapping out an economic plan for opening up new seams in individual mines. A general case study based on three different coalfields is presented to illustrate how production and cost planning problems can be solved.

32672 Subsidence of the west end slope of the "Kosovo" Belacevac opencast mine. Obradovic, R.; Ilic, D.; Dutina, A.; Stamatovic, A. (Rud Inst, Belgrade, Yugosl). *Rud. Glas.;* No. 3, 5-15(1977). (In Serbo-Crotian).

Sliding of the west end slope of the Belacevac opencast coal mine in Yugoslavia occurred between June 17 and 19, 1975. This article describes the landslide, the results of completed geomechanical investigations, an analysis of end-slope stability in the landslide zone, as well as the measures that must be taken to closely monitor and observe further ground movement in this zone. 6 refs.

32673 Development of the new field "Hikishima" in Ikeshima coal mine. Kamono, A. *Nippon Kogyo Kaishi;* **93**: No. 1074, 549-554(1977). (In Japanese).

This article deals with the development of the coalfield and the undersea coal mine on the island of Hikishima, Nagasaki Prefecture, Japan. The mine is now producing 1.2 million tons/yr of bituminous coal. A description is given of the geological survey which included geophysical prospecting and deep sea drilling, the mining operations and transport system, the mine ventilation, cooling and drainage systems, as well as shaftsinking by the short-step and grouting method. Future outlook for the mine is also discussed. 4 refs.

32674 Technical aspects of Belgian coal exploitation in 1975. Medaets, J. (Minist des Aff Econ, Belg). *Ann. Mines Belg.;* No. 7-8, 705-791(1977). (In French).

Technical statistics concerning Belgium coal exploitation in 1975 are presented. These stauistics are subdivided into the following five chapters: (1) general characteristics of production (number of concessions and mining sites, coal deposits mined in 1975, and mining personnel); (2) Technical results of coal exploitation in 1975 (achieved production, yields and consumption); (3) characteristics of underground mining; (4) extraction, cleaning and preparation of products; and (5) analysis of major expansion work in 1975.

32675 Theoretical bases, organizational securing and mining practice of the control of the mountain massif of underground mines in the CSSR. Zamarski, B. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 267-270(1977). (In Czech).

The development of coal mining in the CSSR and the necessity of securing the safety and the rationalization of mining work led, especially after the year 1948, to an intensive growth of scientific studies which enabled skilled decisions to be made in questions dealing with the optimum control of the rock mass. The basic information may be illustrated by the situation in the Ostrava-Karvina coal field, especially since the geological situation of this basin varies in such a way, that there occur in principle all basic problems of rock mechanics, which may in other deposits be met only occasionally.

32676 Problems of disintegration of rocks by means of driving combines. I. Evaluation of the properties of rocks for their mechanical disintegration in the driving of long mining and underground engineering works. Vasek, J. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 271-280(1977). (In Czech).

The methods of rock disintegration realized during the development of driving combines are evaluated and defined, including the properties of rocks which are necessary for the choice of disintegration methods. The results of measurements in the Ostrava-Karvina basin, the basin of Kladno, the construction of the sewer collector in Plzen, the underground in Praha and mining works at the enterprise Smolnik are summarized.

32677 Share of the Scientific Research Institute of Coal in Ostrava-Radvanice in the solution of outbursts of coal, rocks, and gas in the Ostrava-Karvina Basin. Smid, M. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 281-284(1977). (In Czech).

The occurrence of outbursts in the Ostrava-Karvina basin is described. Research in the prevention and forecasting of outbursts is discussed.

32678 Present state of air conditioning in mines of the Czechoslovak mining industry. Brudnik, J. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 285-287(1977). (In Czech).

In the article the methods of artificial cooling of mine air in three Czechoslovak basins, where the excavation is carried out at thermally critical depths are described. The cooling devices used in the mines are described. The further direction of the Czechoslovak research as regards the air conditioning of mines being carried out in the Scientific Research Institute of Coal in Ostrava-Radvanice is outlined.

32679 Explosibility and inflammability of industrial dust. Stroch, V. (Vedeckovyzkumny Uhelny Ustav, Ostrava-Radvanice, Czech.). *Uhli;* **25**: No. 7, 290-293(1977). (In Czech).

The author describes the whole problem of the explosibility and inflammability of coal and industrial dust studied in the Scientific Research Institute of Coal in Ostrava-Radvanice. He describes means and methods for the determination of the explosibility and inflammability of dust which have been studied in the past ten years, and which are used for tests in the state and branch examination

center. He discusses modern methods of prevention verified in the research and experimental work of the Scientific Research Institute of Coal in Ostrava-Radvanice, the purpose of which is to minimize the destructive effect of industrial dust explosions. In conclusion he presents examples of this activity in different technologies, enterprises and branches, including experience gained in this field.

32680 Adaptive control scheme for an underground coal mining section. Dornetto, L.D. (The Citadel, Charleston, SC). pp 101-105 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A critical event model of an underground coal mining section, with shuttle car and continuous miner dynamics, along with an associated adaptive control algorithm is developed. The essential features of the software design are discussed, and the simulation results are summarized.

32681 Characteristics of a cutter-loader with a percussive effector unit. Mitin, L.A.; Fadeev, P.Ya.; Fadeev, V.Ya.; Kulagin, R.A.; Ermilov, N.P. (Inst of Hydrodyn, Acad of Sci of the USSR, Novosibirsk). *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 6, 604-607(1976).

From the results of pit investigations the authors have determined approximate values for the energy parameters of the effector units of a machine with high-energy percussive rock breaking. The effector unit of an entry-driving machine for hard rocks cutting workings 15 m^2--in cross section should have an impact energy of 20,000 kgf-m and a frequency of 60 min^{-1}. The authors give analytical relations for the size of the effector unit and the frame of an entry-driving machine with high-energy breaking. 5 refs.

32682 Striker travel in a pneumatic machine during filling and discharge of the working chamber. Klimashko, V.V.; Smolyanitskii, B.N.; Tkach, Kh.B. (Inst of Min, Acad of Sci of the USSR, Novosibirsk). *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 6, 608-611(1976).

Equations are derived for the lengths of the admission and exhaust strokes of the working chamber from a simultaneous solution of the equations relating the air pressure in the chambers to the admission and exhaust times together with the equations of motion of the striker. 4 refs.

32683 Efficiency of inertial trapping of dust by water drops. Yanov, A.P.; Zhovtukha, G.A.; Shvidkii, N.I. (All-Union Scientific-Research Inst. for Drilling Techniques, Krivoi Rog., USSR). *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 6, 659-664(1976).

Translated from Fiz.-Tekh. Probl. Razrab. Polezn. Iskop.; 12: No. 6, 112-117(1976).

Dispersed water is extensively used to trap dust. In underground workings recourse is often had to water curtains as the only means for dust suppression. In wet dust-trapping devices the water is atomized either during introduction into the device, or in the latter itself by a current of air. In all these cases one is dealing with inertial capture of dust by nonuniformly moving obstacles (drops). A number of theoretical and experimental reports have been devoted to the coefficient of inertial capture of dust by individual stationary barriers. Certain aspects of the problem of dust capture by a moving drop and by a combination of drops moving in a current have been investigated, the authors of the reports concerned making specific assumptions. We have determined the capture coefficient of dust by individual nonuniformly moving drops, and the efficiency of dust trapping by water curtains under the above conditions.

32684 High-efficiency ventillator plants for artificial ventillation of deep open-cut mines. Parakhonskii, E.V.; Severin, L.P. (G.V. Plekhanov Mining Inst., Leningrad, USSR). *Sov. Min. Sci. (Engl. Transl.);* **12**: No. 6, 665-670(1976).

Translated from Fiz.-Tekh. Probl. Razrab. Polezn. Iskop.; 12: No. 6, 117-124(1976).

Ventilation of open-cut mines is now an important problem which has arisen in recent years owing to the continual development and improvement of open-cut mining. Some open-cut mines are now 500 to 700 m deep and are getting 15 to 20 m deeper every year. In the future the rate of deepening may reach 50 m per year and the total depth exceed the 700-m mark. The increased depths of the mines, the use of powerful techniques, and the increasing volume of mining operations are causing the atmospheres of these mines to become filled with large amounts of dusts, gases, and aerosols. This spoils the conditions for natural air exchange and often leads to situations in which health hazards arise. Work must then be stopped, leading to economic disadvantages to the mining undertakings. Such situations can be avoided in most cases only by artificial ventilation of individual stagnant zones and of open-cut mines as a whole. It is found in practice that the most effective pipeless method of ventilating open-cut mines is by free or semibounded turbulent air jets, based on the theory of free submerged jets. The effectiveness of this method depends directly on the range of the jet created by the ventilator plant and on the rate of air flow in the ventilated cross section: the greater these parameters, the less is the time of operation of the ventilator plant needed to normalize the atmospheric conditions in the mine. By the range of the jet we mean the distance from the initial cross section (the point of emergence of the air current from the ventilator) to the ventilated cross section in which the mean velocity of the air just does not exceed the value fixed by the ventilation conditions.

TRANSPORT AND HANDLING

REFER ALSO TO CITATION(S) 32543, 32574, 32591, 32593, 32597, 32598, 32603, 32674, 33536

32685 (CONF-7705111—, pp 5p, Paper 18, Set No. 4) **Long term prediction of coal cleaning performance from exploration samples.** Leonard, J.W. (West Virginia Univ., Morgantown). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The purpose of this technical note is to (1) illustrate the nomographs that can be formed when recovery is phased in with previous work, (2) make note of the powerful potential for predicting future cleaning performance in unmined areas and (3) to discuss resulting mathematical inter-relationships.

32686 (CONF-7705111—, pp 25p, Paper 19, Set No. 4) **Technical and cost comparisons for chemical coal cleaning processes.** Oder, R.R.; Kulapaditharom, L.; Lee, A.K.; Ekholm, E.L. (Bechtel Corp., San Francisco). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Six chemical coal cleaning methods (Hazen process, KUB process, Battelle process, TRW process, Ledgemont Oxygen Leaching process (LDL), and BOM/ERDA process) have beem compared on the basis of conceptual process flowsheets and cost analyses developed from published or patented claims, claims of ash, pyritic sulfur and organic sulfur removal and the nature of the required sulfur product. Under any conditions, chemical coal cleaning per se is not going to be inexpensive. There is ample evidence, however, to indicate that combined physical and chemical cleaning has the potential for making significant reductions in total sulfur for difficult to clean Eastern coals. If this potential can be developed inexpensively in cleaning operations which achieve high Btu yields, then there is an important future for chemical coal cleaning in upgrading the vast Eastern coal resources. Chemical methods should be pursued in applications where physical cleaning is inadequate and where organic sulfur levels are high. The development of chemical methods for these coals should emphasize total sulfur reduction at high Btu yield without requiring coal conversion. In those cases where a moderate grind is sufficient for conventional physical cleaning to efficiently remove mineral sulfur from the coarse coal component, the fine component, often lost in such cleaning methods, could be treated in an auxiliary chemical cleaning process. In this manner, a blended clean coal product could be made which meets sulfur standards, which has both high Btu yield and costs lower than those anticipated for chemical cleaning alone.

32687 (CONF-7705111—, pp 11p, Paper 20, Set No. 4) **Silo vs. barn-type storage for coal.** Mueller, J.K. (Morrison—Knudsen Co., Boise, ID). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Various kinds of coal storage and terminal facilities for loading unit trains are compared. For storage tonnages under approximately 50,000 tons, over-the-track-silos are preferred on a financial basis. For larger tonnages, the trough storage facility requires less capital investment. However, many other factors, which are discussed, should be considered in the decision making process. (LTN)

32688 (CONF-7705111—, pp 13p, Paper 21, Set No. 4) **Noise reduction from vibrating screens.** Hennings, K.S.; Allan, K.N. (Allis-Chalmers Corp., Milwaukee). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Allis-Chalmers recognizes the advent of future requirements for low-noise vibrating screens, and is aggressively working to solve the problem. A special test facility, unique in the industry, was constructed and used to develop design criteria for low-noise screens. This work confirmed that sound levels can be reduced significantly but with a penalty of higher costs. Therefore, selection of final levels should be accomplished with end-user consultation to be sure that the most cost effective solution is applied. Development of an industry noise test standard is an essential step that should be addressed immediately. This will assure that manufacturer's data is

repeatable, comparable, and useful to the plant designer and operator. The standard should include a sound pressure level and sound power level measurement. In addition, development of the standard should include consideration of noise generated by the material being screened.

32689 (CONF-7705111—, pp 10p, Paper 22, Set No. 4) **Teaming switchers and mainliners for economic unit train haulage.** Jacobs, G.W. (General Electric Co., Erie, PA). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

Railroads are economically transporting coal through the use of modern and efficient high capacity cars, high-horsepower mainline electric and diesel electric locomotives, and modern heavy-duty, diesel electric switchers. Each has a specific function to perform: the electric locomotive is on an automated railroad totally dedicated to loading, hauling and dumping unit trains; the mainline diesel locomotive is used in similar service but manually controlled; and the switcher locomotive's task is to load the cars while the mainline diesel is hauling the loads to the generating plant and returning again with empties. Investment in these efficient equipments and machines has proven to be the economical answer to low coal haulage cost today and promises to be the right answer for many years in the future. It remains for the coal companies, utilities, railroads, and equipment suppliers working together to optimize this transportation opportunity. Proper selection of the system and the equipment will make the system operate efficiently and at lowest cost. But, it must be kept in mind that the right answer for one mine/utility/railroad combination may not be the best answer for another. Each must analyze its own set of needs and conditions to achieve its right answer. The payoff for the analysis can be savings in the hundreds of thousands of dollars per year for all participants.

32690 (IS-ICP—53) **Full scale coal preparation research on high sulfur Iowa coal.** Grieve, R.A.; Fisher, R.W. (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 1 Feb 1978. 17p. Dep. NTIS, PC A02/MF A01.

A 63.5 metric tons per hour (70 TPH) demonstration coal preparation plant was constructed on the Iowa State University campus, Ames, Iowa, as a part of the Iowa Coal Project funded by the state of Iowa and administered through the Energy and Minerals Resources Research Institute. Processing equipment in the plant circuit includes a heavy media separator, concentration tables, separating and dewatering screens, and conveying equipment. Coal samples of size 907 metric tons (1000 tons) with sulfur contents ranging from 2.5 to 8.75% sulfur from seven mines in the state of Iowa have been processed in the plant. Sulfur reductions have averaged 35% with ash reduction averaging 45%. Equipment for advanced fine coal beneficiation research is currently being installed in the plant to include a slurry pretreatment circuit, froth flotation, oil agglomeration, pelletization, hydrocylones, advanced design thickener and disc filtration.

32691 (IS-ICP—54) **Iowa Coal Project.** (Iowa State Univ. of Science and Technology, Ames (USA). Energy and Mineral Resources Research Inst.). 15 Jul 1977. 18p. Dep. NTIS, PC A02/MF A01.

Report to the Legislature.

The 1977 report of the Iowa Coal Project to the Iowa Legislature describes the organization of the project and its accomplishments in coal preparation and beneficiation, surface mining, land reclamation, agricultural projects (on reclaimed land), economics, transportation economics, computer programs, legal aspects, etc. Future plans are described briefly. (LTN)

32692 Preventing explosions in fuel preparation systems with ball drum mills and intermediate bunkers. Efroimson, O.A. *Sov. Power Eng. (Engl. Transl.);* **6**: No. 10, 569-571(Oct 1977).

Translated from Elektr. Stn.; No. 10, 19-20(Oct 1977).

Explosions of pulverized fuel which are possible in the fuel preparation systems of power station boilers may sometimes be accompanied by serious equipment failures, and in some cases by personnel injury due to hot pulverized fuel thrown from the safety valves and reflected from the walls and roof. ORGRES made special studies of the operation of 190 fuel preparation systems with ball drum mills and an intermediate bunker with air and gas-air drying of the fuel at 14 power stations and generalized the operational data of 56 more power stations with 620 such fuel systems. Supply of inert exhaust gases as the drying and ventilation agent in fuel preparation systems with ball drum mills and intermediate bunkers is the most effective means of preventing explosions in them with a non-explosive oxygen concentration (less than 16%) under all conditions. Most important in improving the explosion safety of fuel preparation systems is minimization of possible sites of fuel deposition. In new designs for fuel preparation quipment it is necessary to consider operating experience and modifications of individual elements at power stations which have given positive results in elimination of pulverized fuel deposits.

32693 Study of the preparation of milled peat in pulverized fuel systems with ventilator mills. Dunskii, V.D.; Tolchinskii, E.N. *Sov. Power Eng. (Engl. Transl.);* **6**: No. 10, 572-574(Oct 1977).

Translated from Elektr. Stn.; No. 10, 21-27(Oct 1977).

The proportions of moisture removal in the drying shaft and in the ventilator mill cavity are approximately the same at the rated peat charge. With increase of the charge the proportion of moisture removal in the ventilator mill decreases. With a constant proportion of exhaust gas recirculation through the fuel system, the ash content of the fuel is proportional to the initial ash content of the peat. The fuel concentrator design used prevented clogging of the concentrator with wood inclusions and provided thorough separation of the pulverized fuel. The specific consumption of electrical energy on milling and air transport decreases with increase of the air mixture temperature.

32694 Rail operation at the Fortuna opencast mine and its technical development. Fries, D.; Meyer, W. *Braunkohle;* **29**: No. 9, 356-363(Sep 1977). (In German).

Provided is an overview of the construction of the rail system at the Fortuna opencast mine with its technical equipment. High-capacity cars for overburden and coal, electric locomotives and the pertinent train safety systems are described, including the most modern central signal box. Underlined in particular are the technical innovations and improvements made in all sectors. In conclusion, the development of the rail system is described and shown in perspective with the new connections to the Bergheim and Hambach opencast mines.

32695 Planning, construction and putting into commission of the new conveyor collecting point in the Fortuna opencast mine. Schulze, H.J.; Kneschke, H. *Braunkohle;* **29**: No. 9, 369-379(Sep 1977). (In German).

The problems connected with the setting-up of a new conveyor collecting point at the Fortuna opencast mine are described. The most difficult problem in this respect was the necessity to put the conveyor collecting point into commission and make all the reconnections from the old to the new conveyor collecting point so that any standstill of plant and equipment was avoided as far as possible. Discussed in detail are the necessary measures taken in the planning and building development phase.

32696 Designing and evaluating the effectiveness of e-shaped magnetic systems for self-unloading electromagnetic suspension separators. Bul, B.K.; Zakharova, M.S.; Smolkin, R.D.; Ustinova, R.G. *Sov. Electr. Eng. (Engl. Transl.);* **47**: No. 9, 97-104(1976).

Self-unloading electromagnetic suspension separators serve to protect process equipment against random entry of ferromagnetic objects together with the loose material being processed (coal, for example). They are widely used in the coal, power, and other industries. A method is proposed for designing the E-shaped magnetic systems of electromagnetic suspension separators designed to extract random ferromagnetic objects from loose magnetic materials. 11 refs.

COMBUSTION

REFER ALSO TO CITATION(S) 32572, 32613, 32619, 32978, 33306, 33307, 33308, 33320, 33987

32697 (AED-Conf—77-195-008) **Problems encountered with burning high ash coal in Spain.** Blas, J.G. (Central Termica de Soto de Ribera, Oviedo (Spain)). 1977. 49p. (In Spanish and English). (CONF-770695—6). Dep. NTIS (US Sales Only), PC A03/MF A01.

From International conference on fireside corrosion and contamination in thermal power stations; Essen, F.R. Germany (1 Jun 1977).

Effects of slagging and erosion on the operation and the modification of two boilers of the Soto de Ribera thermal power station are reported on. The boilers, which are briefly described, are designed for the use of low-grade coals (35 to 45 ash content). Measures for avoiding the damage as well as the results achieved are described.

32698 (ANL/CEN/FE—78-1) **Highlights of studies on fluidized-bed combustion of coal, 1977.** Jonke, A.A.; Carls, E.L.; Vogel, G.J.; Johnson, I. (Argonne National Lab., Ill. (USA)). Feb 1978. Contract W-31-109-ENG-38. 32p. Dep. NTIS, PC A03/MF A01.

The highlights of the fluidized-bed coal combustion program at Argonne National Laboratory are described. Studies of the regeneration of sulfated limestone were conducted using the Laboratory's process development unit. The effects of operational variables on the regeneration process were investigated. The conditions which lead to agglomeration of the partially sulfated limestone and coal in the

regenerator, and therefore defluidization, were established. Cyclic sulfation-regeneration studies were made on Greer limestone, and the overall economic feasibility of regeneration was studied. Laboratory TGA measurements at high temperatures were used to predict the performance of several limestones at the high temperatures used in carbon burnup cells; a significant SO_2 reactivity was predicted. The mechanism of the process by which NaCl enhances the SO_2 reactivity of limestone was established. The effectiveness of various clay minerals, silica gel, and activated bauxite for the removal of gaseous alkali metal compounds from a hot gas stream was measured. The results of studies of the filtration efficiencies of granular-bed filters for the removal of dust from the flue gas generated with a pressurized fluidized-bed combustor are reported. Two commercial light-scattering particle analyzers were tested, using the flue gas from the PFBC. The status of the design of the Component Test and Integration Unit (CTIU) is described. The CTIU is a pressurized fluidized-bed coal combustion test rig (3 megawatts) designed to allow various combustor configurations to be easily assembled and tested.

32699 (FE—2327-19) **Evaluation of heat exchanger and turbine materials for use in a coal fired fluidized bed combustion environment. Task II. Monthly technical report, January 1978.** Clark, J.W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Research and Development Center). Feb 1978. Contract EX-76-C-01-2327. 11p. Dep. NTIS, PC A02/MF A01.

Analysis of the data collected during the 100 h shakedown run conducted in the Exxon PFBCC in December is in progress. Temperature measurements, recorded at 10 or 20 min intervals, were in general rather uniform for each individual point. Statistical treatment of the data serves to identify certain periods of the test in which bed conditions were relatively unstable with respect to the balance of the test duration.

32700 **Material and energy uses of hard coal.** Keil, G.; Klare, H. (Akademie der Wissenschaften, Berlin). *Koks, Smola, Gaz;* **22**: No. 10, 245-248(Oct 1977). (In Polish).

The actual state and trends of material and energetic utilization of energy carriers are discussed with special attention to hard coal. New possibilities are put forward for a better use of hard coal as energy carrier and raw material for obtaining a series of valuable products.

32701 **There is no other way than coal. ENERGIE interview with Prof. Dr. Werner Peters.** *Energie;* **29**: No. 7, 193-195(Jul 1977). (In German).

The main point of the interview are the development and the advantages of coal-fired power plants with fluidized-bed combustion. Compared with conventional power plants with flue gas desulfurization, the investment costs are 20 to 25% lower. An experimental plant (100-200 kg coal/h) for the determination of the desulfurization and for measuring the heat transfer values on the heat pipes in trial operation has now been taken into operation. A plant with a thermal power of 50 MW at a pressure of 5 bar is still in the planning stage. The next step will be a 100 MW plant. Due to modular construction, there is practically no upper limit.

32702 **Ash fouling in the combustion of low rank western U.S. coals.** Sondreal, E.A.; Tufte, P.H.; Beckering, W. (US ERDA, Grand Forks, ND). *Combust. Sci. Technol.;* **16**: No. 3/6, 111-121(1977).

Ash fouling of heat transfer surfaces, the most serious operating problem of boilers fired on low-rank Western U.S. coals, is discussed in detail. The characteristics of western coals are analyzed and improvements in the design of boilers for high fouling coals are suggested. Further, the mechanism of ash fouling is explained, and recent research work on ash fouling and remedial measures is outlined. 44 refs.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 32654, 32671, 32674, 33238, 33245, 33246

32703 (ANL/AA—16) **National coal utilization assessment: effects on regional coal markets of the "best available control technology" policy for sulfur emission.** Krohm, G.C.; Dux, C.D.; VanKuiken, J.C. (Argonne National Lab., Ill. (USA)). Dec 1977. Contract W-1-109-ENG-38. 60p. Dep. NTIS, PC A04/MF A01.

This report analyzes the effects on regional coal markets of a policy requiring the "Best Available Control Technology" (BACT) for sulfur emissions. Four likely BACT implementation strategies are defined and tested in a detailed model of U.S. coal markets. The study estimates the effects of BACT on regional coal production, interregional shipments, and coal utilization costs. Initially, any BACT policy will have small effects on coal markets but will substantially alter market patterns between 1985 and 1990. With or without BACT, production levels in the Northern Great Plains will remain at boom levels through about 1985. Differences in regional production shares among alternative BACT scenarios are minor in 1990 and almost negligible in 1985. Alternative BACT policies do not sifnificantly change the cost of burning high sulfur coal. Once the use of scrubbers is required, variations in the sulfur removal efficiency between 75% and 90% have minimal effects on the total cost of using coal. This helps to explain why the differences in market impacts among the four scenarios are generally insignificant. BACT policies will have two effects on coal combustion costs. In those areas where Western low sulfur coal is now used to meet NSPS, the costs of coal utilization (fuel plus control costs) will increase by 20 to 25%. In those areas where Eastern high sulfur coal is being used to meet NSPS, costs will increase by only 8 to 10%. In both cases, the increased costs will make coal-generated electrical power more expensive relative to nuclear power. This should widen the apparent cost advantage of nuclear plants in many areas. For those utility applications where coal is still a competitive fuel, the costs of power will increase by at least 2 mills/kWh.

32704 (CONF-7705111—, pp 11p, Paper 3, Set No. 1) **Industry's plans for supplying the Nation's coal.** Bailey, R.E. (Colsolidation Coal Co., Pittsburgh). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The coal industry feels it can meet the President's 1985 target of an extra 400 million tons per year. Mining equipment manufacturers have moved to expand plant capacity, however, labor relations leave something to be desired (due mainly to illegal, wildcat strikes); more manpower is needed, including training in work skills and safety; and there are some governmental regulation roadblocks. The latter involve reclamation legislation that would slow down or prohibit surface mining in some areas, Clean Air Act amendments, coal transport problems, Federal coal land leasing restrictions, etc. (LTN)

32705 (CONF-7705111—, pp 16p, Paper 4, Set No. 1) **Government's perception of the role of coal in the total energy picture.** O'Leary, J.F. (Federal Energy Administration, Washington, DC). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The US energy situation is reviewed from the end of World War II to the present. At the end of that war the US still had considerable reserves of oil and was able to maintain a stable, low price for crude oil. In 1965 we had 3.5 to 4 million barrels a day in shut-in capacity. But by 1970 this cushion was gone and the stage was set for the OPEC action a few years later. Hardly anyone foresaw this development and coal gasification and coal liquefaction projects were cancelled or cut back in the 50's and 60's. Now it is apparent that we are running down our reserves of natural gas and oil and need enormous new discoveries each year to merely maintain the situation. The President's energy plan involves conservation of oil and gas, shifts away from oil and gas to coal or nuclear energy and more exploration (e.g., on the continental shelf). Meanwhile, electric utilities are suffering from a reduction in energy demand in 1973 and 74 instead of a 7% annual growth), a serious cash flow decline and rapidly increasing costs (with difficulty and delays in getting rate increases). Further, many uncertainties exist: uncertainties with respect to air quality legislation, changes from gas to oil because it is the path of least resistance (but may cause more difficulties in the future), long lead time for plant construction (especially nuclear), uncertainty that coal industry can expand sufficiently, get finances needed or that the coal can be transported. (LTN)

32706 (EMD—78-22) **State of competition in the coal industry.** Staats, E.B. (General Accounting Office, Washington, D.C. (USA)). 30 Dec 1977. 79p. Accounting Office, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

A major part of United States energy policy is the maintenance of competition in the energy sector of the economy. Such competition must exist both within and among industries in this vital sector of our economy. This report analyzes the state of competition in one energy industry, coal production, and examines the potential for outside domination of this industry, particularly by petroleum companies. It is concluded that a viable state of competition exists in the coal industry. Unless circumstances change, domination by any firm or group of firms is unlikely. Control of current production is shared by numerous firms and ownership of coal reserves is dispersed even more. On a nationwide basis, petroleum firms account for less than 20 percent of total production and even less of coal reserves. The degree of competition varies. In the Eastern market, large numbers of firms actively compete in both contract and spot sales; reserve ownership is well dispersed. In the two Western markets, however, the situation is dynamic and requires the contin-

ued vigilance by the Federal Trade Commission and the Department of Justice as well as by the Interior Department through its coal leasing program.

32707 Guideline concerning investment aid grants for undertakings of the German mining industry. Dated from 19th August 1977. *Bundesanzeiger;* **29**: No. 156, 1-2(Aug 1977). (In German).

The maximum amount which may be granted is to be calculated on the basis of the ratio utilizable haulage of the enterprise in 1976: overall utilizable coal haulage in the FRG in the same year. The aid may not exceed 30% of the acquisition and/or production costs for the investments.

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 32623, 32625, 32627, 32628, 32629, 32630, 32631, 32632, 32633, 32648, 32672, 32675, 32683, 32684, 32688, 32692, 33487, 33696, 33697, 33699, 33987, 33989, 33990, 33991, 33993, 33994, 34003, 34004

32708 Use of knowledge and experience in directives concerning gas outbursts. Siebers, U. *Glueckauf;* **113**: No. 18, 899-903(15 Sep 1977). (In German).

The mechanism set forth by the guidelines for the North Rhine-Westphalia coal district concerning the recognition and elimination of danger due to gas bursts is explained, distinguishing between preliminary inspections designed to corroborate a suspicion of a gas burst hazard and recognition procedures designed to limit the extent and duration of an actual burst. Examples of the effectiveness of measures such as the drilling of gas release boreholes are cited. 9 refs.

32709 Explosion in the gas works. Larsen, J.P. (Feuerwehramt, Hamburg (Germany, F.R.)). *Brandschutz;* **31**: No. 6, 164-166(1977). (In German).

One person was killed and two others wounded in an explosion of the medium-pressure compressor at the Hamburg-Kattwyk gas works. There was considerable damage to buildings and machinery. The plant, the circumstances of the explosion, and its causes are described.

32710 Private views on the cause of gas outburst. Hyogo, S. *Nippon Kogyo Kaishi;* **93**: No. 1074, 537-542(1977). (In Japanese).

Gas bursts in Japanese coal mines have been increasing along with ever-greater working depths. Since the cause and mechanism of gas bursts are not always fully clarified, the author examines this problem on the basis of experience gained in practice, and attempts to find some protective measures which would be suitable for Japanese coal-mine conditions. The author's personal views on the cause and mechanism, as well as the pressure and volume of gas bursts are presented.

REGULATIONS

REFER ALSO TO CITATION(S) 32644

32711 From jurisdiction and mining administration. When does a project particularly deserve to be promoted within the meaning of the Coal Act. *Glueckauf;* **113**: No. 1, 47(Jan 1977). (In German).

An enterprise which operates a coal-fired power station, enlarged this station by another four units on the basis of natural gas and applied for a certificate pursuant to section 32, sub-section 2 of the KohleG. The Federal agent rejected the application. The enterprise called on administrative jurisdiction, however, without success in the first and second instance. The Higher Administrative Court at Muenster recorded in its verdict, the certificate applied for could not be issued, as the extension of the power station by four units on the basis of natural gas would not particularly deserve promotion within the meaning of section 32, sub-section 2 no. 1 of the KohleG from the point of view of the national economy.

PETROLEUM

RESERVES

REFER ALSO TO CITATION(S) 32721, 33250

32712 U.S. oil resources: the critical years. Masters, C.D. (US Geol Surv, Reston, Va). *Pet. Eng.;* **49**: No. 13, 40, 42, 44(Dec 1977).

The author analyzes the U.S. oil reserves, including those which are economic (recoverable), subeconomic (potentially recoverable) and nonrecoverable. He concludes that, for the next few decades, the resource base is not limiting but the rate of discovery and production is. Looking beyond those next few decades, however, plans must be made to develop the technology to alter the energy mix and reduce consumption. Even if a significant amount of oil is to come from remote or unconventional sources, the lag time is expected to be frustratingly long.

32713 Petroleum and gas geological regions of the far eastern marginal seas. Alekseichik, S.N.; Zavadskii, V.A. (All-Union Sci Res Min Inst, USSR). *Geol. Nefti Gaza;* No. 6, 37-40(Jun 1977). (In Russian).

The necessity of dividing the petroleum geological elements into two groups: the petroleum and gas generating (PGG) and petroleum and gas accumulating (PGA) groups is pointed out. The PGG group includes: zones, provinces megabasins, basins and subbasins. Within these, mainly petroleum and gas collecting expanses relatively small PGA sectors are singled out: regions, districts, areas, deposits, and beds. The Far Eastern seas are classified as Cenozoic epigeosynclinal PGG megabasins.

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 32712, 32727

32714 (KIYI—76-19) Experiments on the water-oil contact repulsion on a model of a well using $^{13}C(\gamma,n)^{12}C$ reaction. Lomonosov, V.I.; Parlag, A.M.; Sikora, D.I.; Sychev, S.I.; Udod, V.A.; Shkoda-Ul'yanov, V.A. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1976. 8p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Experiments were carried out on determination of the repulsion coefficient of water-oil contact by pulsed gamma-neutron logging (PGNL) on a model of a well with oil-saturated and water-saturated layer interface. It is shown experimentally on the model that ratio of the registrated photoneutrons from the oil-saturated layer (OSL) to those from the water-saturated layer (WSL) for fresh layer waters reaches 1.48(+-)0.06 at the accelerated electron energy E = 7.5 MeV.

32715 Depositional environments and petrology of the Gilwood member north of the Peace River arch. Rottenfusser, B.A.; Oliver, T.A. (Alberta Res Counc, Edmonton). *Bull. Can. Pet. Geol.;* **25**: No. 5, 907-928(Sep 1977).

The study describes and interprets, from core analysis, the petrology and depositional environments of the Gilwood sandstones and associated Watt Mountain shales in the area northeast of the Peace River arch. The study is restricted to the area north of the zero-edge of the Elk Point evaporites, where the sands of the Watt Mountain Formation can be readily distinguished from older Devonian sands and regolith on the Precambrian. Interpretation of the depositional environments may aid in future definition of potential hydrocarbon reservoirs in an area where the updip stratigraphic pinchout of the Gilwood sand has been repeatedly tested. 28 refs.

32716 Depositional environments, Foremost formation (late cretaceous), Milk River area, southern Alberta. Ogunyomi, O.; Hills, L.V. (Texaco Overseas Pet Co, Lagos, Niger). *Bull. Can. Pet. Geol.;* **25**: No. 5, 929-968(Sep 1977).

Paleoenvironmental interpretations based on sedimentological and micropaleontological analyses indicate that the Late Cretaceous (Campanian) Foremost formation is transitional between the underlying marine Pakowki Formation and the overlying nonmarine Oldman Formation. The sediments of the Foremost Formation in the study area were deposited in marginal-marine shoreline environments during the northeast withdrawal of the Pakowki sea. Five depositional cycles were recognized in the paralic sediments of the Foremost formation. Paleocurrent and petrographic analyses indicate that principal source areas for the Foremost and Oldman sediments were located to the southwest in Montana. Refs.

32717 Preliminary geochemical evaluation of the Arctic Islands. Henao-Londono, D. (Panarctic Oils Ltd, Calgary, Alberta). *Bull. Can. Pet. Geol.;* **25**: No. 5, 1059-1084(Sep 1977).

Maps of organic maturation in critical stratigraphic units, combined with organic-richness maps and kerogen identifications, provide the basis for a preliminary geochemical evaluation of the oil and gas potential of the Sverdrup Basin and the Franklinian Geosyncline in the Canadian Arctic Islands. Results of the study indicate that the main shale and siltstone units in the Islands have sufficient organic carbon content to be potential source rocks in one part or another of the archipelago. Isotope analyses indicate that the gas in the seven large gas fields thus far discovered is of early thermal origin. Available information is insufficient to determine the parent rock of these gases and of at least three types of oils found thus far in

the Sverdrup Basin, or of the oil discovered recently in carbonates of Devonian age. 8 refs.

32718 Strategy and tactics of oil exploration. Sozanskii, V.I. (IGN, Acad of Sci of the Ukr SSR). *Geol. Nefti Gaza;* No. 7, 62-69(Jul 1977). (In Russian).

The present-day high rates of petroleum extraction require finding new oil exploration objects. It is suggested that weathered outcroppings of the crystalline foundations and thick extra-deep zones of loosened crystalline crust be explored for oil and gas. In particular, the drilling of a borehole to the depth of 12 km at the Golubovskoye gas and oil deposit in the SW of the Dnierper-Donets depression in the Ukraine is proposed. 14 refs.

32719 Analysis of success rate of explorational drilling for oil and gas in the USA. Kurov, A.V. *Geol. Nefti Gaza;* No. 7, 69-73(Jul 1977). (In Russian).

Based on a comparison of the structure of the prospecting and exploratory drilling and the increase in oil and gas reserves in the USA, the present state of the productivity (in terms of the increase of reserves per borehole or per 1 m of drilling) is analyzed for individual categories of wells and stages of work. Changes in the productivity of drilling in the last few years are shown. It is concluded that exploratory and prospecting drilling in the USA is characterized by low productivity, that mainly small oil and gas deposits are discovered, that the rated value of productivity of exploratory drilling is 1.8 time smaller than actual productivity.

32720 Results of geological prospecting for oil and gas in the south of the Siberian platform and the tasks of their further development in the tenth five-year plan period. Samsonov, V.V.; Povyshev, A.S.; Ryb'yakov, B.L.; Tyshchenko, L.F.; Mandel'baum, M.M. (East Sib Geol Surv, USSR). *Geol. Nefti Gaza;* No. 6, 1-12(6 Jun 1977). (In Russian).

An evaluation of the prospects of finding oil and gas deposits in different areas of the Irkutsk amphitheater is made. The main lines of further oil and gas prospecting, the ways and methods of improving its effectiveness are determined. So far, oil and gas-bearing basis of different age have been discovered in the Irkutsk region, Krasnoyarsk territory, and Yakutian ASSR. The main among them is the extensive Nepskii arch (150,000 km²) in the NE part of the Irkutsk region where several oil and gas-bearing areas have been discovered.

32721 Ultimate petroleum resources in northeastern British Columbia. Dewar, D.W. (Dep of Mines and Petr Resour, Victoria, BC). *Bull. Can. Pet. Geol.;* **25**: No. 3, 635-659(Jun 1977).

This paper attempts to estimate the amount of hydrocarbon remaining to be found in northeastern British Columbia, utilizing present reserves, present exploration drilling densities and optimum drilling densities. The method requires an appraisal of the formations containing hydrocarbon and a prediction of the continuity of these formations. The sedimentary section was divided into ten separate units consisting of one or more formations. In each unit, the present reserves and the present drilling densities were used to estimate the ultimate resources. From this method the ultimate resources were determined to be 25 million cu ft of gas and 829 million bbls of oil. 16 refs.

32722 Developments in Canada in 1976 "gas becomes king". Ower, J.R. (Chevron Stand Ltd, Calgary, Alberta). *Bull. Can. Pet. Geol.;* **25**: No. 3, 660-682(Jun 1977).

A review is given of Canada's exploratory and development drilling for oil and gas, as well as of geophysical activity, and the main Phanerozoic basins of Canada are outlined in graphic form. Proven and probable reserves of crude oil and natural gas liquid reserves are surveyed, showing a decline in both for 1976. While last year's crude oil production suffered a 12% decline from the year before, natural gas output was 6,962 million cu ft/day, up about 8%.

32723 Analysis of wave dielectric logging. Denisov, S.B.; Makagonova, S.K. *Prikl. Geofiz.;* No. 84, 219-224(1976). (In Russian).

A method for determining the relationship between dielectric permeability and rock porosity, petroleum-saturation and water-saturation by measuring differences in rock phases and specific resistance is described on the basis of the experimentally established relationship. The analytical dependence of Δphi on rho and k/sub B/ is suggested. The dielectric permeability is shown to depend essentially on k/sub B/ alone. k/sub B/ computation errors in using the suggested methodology are evaluated. 2 illustrations, 4 titles.

DRILLING AND PRODUCTION

REFER ALSO TO CITATION(S) 32747

32724 (ORO—5302-19) Tertiary oil recovery by CO_2 injection. Monthly report, October 1977. Conner, W.D. (Columbia Gas Transmission Corp., Charleston, W.Va. (USA)). 1977. Contract EF-76-C-05-5302. 21p. Dep. NTIS, PC A02/MF A01.

Water injection continued during October with a total of 5443 barrels being injected. Oil production for October amounted to 1732 barrels, a decline of approximately 150 barrels from September and a decline of approximately 700 barrels from the June high. Total recovery to date, due to CO_2 injection is 7989 barrels. Flow tests were also run on observation well 2024. Bottom hole pressure tests were run in only two of the observation wells due to mechanical difficulties with the wellheads.

32725 Surfactant evaluation and laboratory optimization of the chemical flooding process for high salinity oilfield water environment. Marx, C.; Murtada, H.; Burkowsky, M. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung). *Erdoel-Erdgas Z.;* **93**: No. 9, 303-310(Sep 1977). (In German).

Objective, concept and performance of flood tests with surfactants are outlined. The project is supported by the German Government. The evaluation criteria for surfactants to meet the conditions prevailing in oilfields of North Germany with high salinity waters, including tests in porous media are described. The special equipment developed for the project is explained. First results for a selected oilfield are reported as well as the future program of the project.

32726 Unconventional oil. IV. Improving production from petroleum reserves: enhanced recovery. Sajus, L. (Inst Fr du Pet). *Rev. Energ.;* **28**: No. 296, 131-148(1977). (In French).

The importance of enhanced recovery is emphasized, the diversity of liquid hydrocarbon reserves is recalled, and the major techniques of enhanced recovery are described, namely: water flood and its improved variants, gas drive and its new forms, supplying thermal energy to the field. A table is given summarizing the requirements for applying different enhanced recovery methods. Economic aspects of enhanced recovery are discussed and forecasts of its application in the future are made.

32727 Unconventional oil. V. Deep sea oil myth, reality of today, or future necessity. Rutman, G.; Bernard, F. (Soc Natl Elf-Aquitaine, Fr). *Rev. Energ.;* **28**: No. 296, 149-161(1977). (In French).

Despite the growth of deep sea exploration since 1975, as clearly shown by the world statistics for the number of wells drilled annually in depths exceeding 200 meters, this effort is still too insignificant for statistical use. In effect, in 1976, this item only accounted for about 0.1% of the total number of exploration wells drilled worldwide. It is estimated that reserves of oil in deep sea deposits amount to 420 to 1050 billion barrels, of which 0.7 billion barrels are proven reserves. The present status of technology is reviewed and it is concluded that for deep sea drilling the presently used systems based on the principle of a rigid connection between the seabed and the platform are unsuitable. Floating platforms and multiple connections between the seabed and the surface are suggested for this purpose.

32728 Basic tasks in developing new sets of electrical equipment for the oil and gas industries. Onishchenko, G.B.; Portnoi, T.Z.; Mosesova, I.G. *Sov. Electr. Eng. (Engl. Transl.);* **47**: No. 8, 9-11(1976).

Some of the principal tasks for the development of new electric equipment for oil and gas industries in the USSR envisaged by the Tenth Five-Year Plan are outlined. They include the following: an increase in the level of process electrification and provision of electrical equipment to labor in the oil and gas industry, an increase in the power of basic units and mechanisms for drilling, recovering, and transporting oil and gas, a greater degree of automation of drilling rigs, recovery assemblies, and gas and oil pumping stations, the development of equipment designed to operate under low-temperature conditions, in maritime climates, the development of equipment having good and universal installability in modular form with a high degree of factory availability, an increase in the operating reliability of the equipment. In particular, integrated transformer substations for 35/6/0.4 kV of up to 2500 kVA capacity and standardized integrated switchboards for 6 and 0.4 kV to provide electric service to basic customers: drill rigs, submersible electric pumps, and pump installations with pumping units are envisaged. The type PBP-6000/200 semisubmerged drill platform, the first in the Soviet Union, will be developed. Powerful 180, 250, and 350 kW submersible electric motors will be developed for submersible electric-pump units. Development of water-filled submersible motors of up to 1000 kW will commence.

PROCESSING

REFER ALSO TO CITATION(S) 32580

32729 Quality control in a sophisticated petroleum refinery. Varghese, T.V.; Rao, B.H. (Madras Refineries Ltd, India). *QR J.;* **4**: No. 2, 81-83(May 1977).

This paper deals with the quality control aspects in a sophisticated petroleum refinery. In addition to reviewing testing procedures of raw materials and products and their significance, a brief outline of the organization necessary for carrying out this work is included.

32730 Steam-hydrocarbon process. Pinto, A. (to Imperial Chemical Industries Ltd.). US Patent 4,072,625. 7 Feb 1978. Priority date 3 Mar 1975, United Kingdom of Great Britain and Northern Ireland (UK). 12p.

In a process of reacting a hydrocarbon with steam and/or carbon dioxide in a reaction zone heated by a combustion furnace to give olefins or process gas containing carbon oxides and hydrogen, high grade heat is recovered from furnace flue gases and/or process gas whereby to cool such gases to 150 to 300°C. When the process gas is used in a synthesis of for example methanol or ammonia, gases at 150° to 300°C are also produced. Previously the recovery of heat from such low grade heat sources has been inefficient or inconvenient. According to the invention the heat is recovered by means of an intermediary liquid coolant, which is brought into direct heat exchange with streams to be used in the process. Preferably the liquid is water under pressure and is brought into direct heat exchange with a gas to be fed to the process; by this means 10 to 30 percent of the steam can be provided from low grade waste heat.

32731 Hydrodesulfurization of hydrocarbon distillate with a catalyst composite of carrier, PT/PD, RH, and SN. Rausch, R.E. (to UOP Inc.). US Patent 4,070,272. 24 Jan 1978. Filed date 9 Mar 1977. 26p.

Desulfurization of a sulfurous hydrocarbon distillate containing a mono-olefinic hydrocarbons and aromatics is carried out by reacting the distillate with hydrogen in contact with a catalyst composite of a carrier, a platinum or palladium component, a rhodium component and a tin component. The carrier may be alumina, alumina—boria, silica—alumina, chromia—alumina, alumina—silica—boron phosphate or crystalline aluminosilicate.

32732 Hydrocracking of hydrocarbons over tri-metallic catalyst. Rausch, R.E. (to UOP Inc.). US Patent 4,070,270. 24 Jan 1978. Filed date 9 Mar 1977. 26p.

A process is described for hydrotreating (hydroprocessing) hydrocarbons and mixtures of hydrocarbons utilizing a catalytic composite of a porous carrier material, a platinum or palladium component, a rhodium component and a tin component, in which process there is effected a chemical consumption of hydrogen. A specific example of one such catalyst is a composite of a crystalline aluminosilicate, a platinum component, a rhodium component and a tin component, for utilization in a hydrocracking process. Other hydrocarbon hydroprocesses are directed toward the hydrogenation of aromatic nuclei, the ring-opening of cyclic hydrocarbons, desulfurization, denitrification, hydrogenation, etc.

32733 Catalytic oxidation of mercaptans and removal of naphthenic acids, catalyst toxins, and toxin precursors from petroleum distillates. Carlson, D.H.J.; Urban, P. (to UOP Inc.). US Patent 4,070,271. 24 Jan 1978. Filed date 4 Mar 1977. 12p.

A process is disclosed for the catalytic oxidation of mercaptans in a sour petroleum distillate containing difficultly oxidizable mercaptans, catalyst toxins and catalyst toxin precursors. The process comprises treating said distillate in contact with an alkaline solution and extracting naphthenic acids from the distillate; treating the substantially naphthenic acids-free distillate in contact with an oxidizing agent and an alkaline solution of a metal phthalocyanine catalyst, oxidizing the residual catalyst toxins and toxin precursors contained therein and converting a portion of the mercaptans to disulfides; passing the resulting reaction mixture through a bed of solid adsorbent particles and adsorbing the oxidized toxins and toxin precursors and the metal phthalocyanine solution thereon; treating the toxin-free and toxin precursor-free distillate in contact with an alkaline solution and a supported metal phthalocyanine catalyst in the presence of an oxidizing agent; and recovering a distillate substantially free of mercaptans.

32734 Hydrodesulfurization of mazout (heavy residue) from Russian crude oil. Kiezel, L.; Rutkowski, M. (Politech Wroclawska, Pol). *Przem. Chem.;* **56**: No. 9, 471-474(Sep 1977). (In Polish).

The role and importance of mazout hydrodesulfurization in the refinery industry has been discussed. The results of hydrodesulfurization of atmospheric residue (S-2.86w.%) on catalysts G - 1 and Co, Mo/ME-V obtained at large laboratory scale, have been presented. On the catalysts mentioned it is possible to obtain mazouts of medium degree of desulfurization (S=1 w.%) and of high degree of desulfurization (S<=0.35 w.%). Mazouts with a low content of sulfur (S<=0.4 w.%) are a source of high quality refinery semiproducts, raw materials for the processes of catalytic cracking, hydrocracking and coking. 7 refs.

32735 Selective refining of oil fraction with furfurol in a disc extractor. Miszka, J.; Atamanczuk, B. (Inst Ciezkiej Synt Org "Blachownia", Redzierzyn, Pol). *Przem. Chem.;* **56**: No. 9, 474-476(Sep 1977). (In Polish).

Using the mathematical methods of experiment planning the regression equation has been described. The equation shows the effect of solvent to distillate ratio (within the range of 1.5 to 3.5) and temperature gradient (from 50 to 70°C)k upon the course of selective refining in a disk extractor. Vacuum distillate P_4 of the Russian crude has been used as the starting raw material. 6 refs.

32736 Catalytic cracking. The hydrocarbon cracking on amorphous crystalline aluminium oxide/silicon oxide catalysts. Schulz, H. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte-Institut); Geertsema, A. (Potchefstroom Univ. for C.H.E. (South Africa)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **30**: No. 7, 313-321(Jul 1977). (In German).

The use of zeolite catalysts instead of amorphous aluminium oxide/silicon oxide considerably influences the method in catalytic cracking. Therefore in the present work, aliphatic and alicyclic hydrocarbons as well as mixtures of these were cracked on zeolite and also on amorphous catalysts. The temperature and contact times were varied. The spectrum of products and the conversion in the reaction have considerably changed. Applying a special sampling technique and an efficient use of gas chromatography, the products could be accurately identified. This enables a deep look into the course of primary and secondary splitting, rearrangement, and hydrogen transfer reactions. The main difference in using zeolite catalysts is due to the hydrogen transfer reactions.

32737 Method for the desulfurization of a petroleum containing asphalt in the presence of a catalyst. Gatsis, J.G. (to Universal Oil Products Co., Des Plaines, Ill. (USA)). German(FRG) Patent 1,645,817/B/. 24 Jun 1976. 3p. (In German).

Crude petroleums as well as distillation residues can be desulfurized in spite of their high asphalt content. Known combinations of the type of Co-Mo-Al_2O_3 catalysts are used as catalysts, whose life time and activity can be increased using this method as compared to the usual methods. This is achieved by adding about 20% steam relative to the mass of the oil used. The thus increased activity enables one to limit the temperature at the exit of the adiabatically operated reactor to about 430°C, so that splitting reactions of the hydrocarbons do practically not occur and hence a deactivation of the catalyst through deposited coke can be prevented. The degrees of desulfurization achieved in tests with a Ni-Mo-Al_2O_3-SiO_2 catalyst are over 80%. About 50% of the asphalt is decomposed at the same time due to the steam addition. The catalyst did not show any activity reduction in these tests after 550 hours of operation.

PRODUCTS AND BY-PRODUCTS

REFER ALSO TO CITATION(S) 32734, 32735, 32867, 32869, 32871, 33248, 33249

32738 New olefin plant. The Esso Chemie GmbH in Cologne invests DM 3.3 million per place of work. *Chem. Prod. (Munich);* **6**: No. 6, 20-21(1977). (In German).

The production of ethylene, propylene and butadiene by steam cracking based on naphtha at about 860°C is briefly discussed within the framework of the expansion of the Esso chemistry plants in Cologne. The capacity has been increased from 120,000 t/a ethylene to 450,000 t/a. The parameters to be considered in expanding the steam cracking plant, such as environmental problems due to noise and SO_2 emission, cost questions and product amounts are described.

32739 Adulterated gasoline: certain methods of detecting the most common frauds involving petroleum products. Illardi, A.M. (Stn Sper per i Combust, San Donato Milanese, Italy). *Riv. Combust.;* **31**: No. 7/8, 248-253(1977). (In Italian).

In Italy automotive fuels, because of high taxes, are more expensive than other hydrocarbon products or derivatives. Unscrupulous vendors may therefore add some of these latter products to gasoline. A combination of analytical techniques is proposed for detecting three different classes of frauds--namely, the addition of a certain quantity of another petroleum product (usually kerosene or gas oil: to "orthodox" gasoline, the addition of the afore-mentioned together with more volatile products, and the production of a mixture in which "orthodox" gasoline represents only a small percentage (20 to 30%) of the total.

MARKETING AND ECONOMICS

32740 (AD—045211) **Analysis of reference prices for Westpac JP-4 procurement.** Bradshaw, E.P.; Herrick, D.M. (Air Force Inst.

of Tech., Wright-Patterson AFB, Ohio (USA). School of Systems and Logistics). Jun 1977. 135p. (AFIT-LSSR—12-77A). NTIS PC A07/MF A01.

The Defense Fuel Supply Center procures JP-4 fuel requirements for the Western Pacific market area using fixed price contracts with escalation. Currently, several reference prices are used in DFSC contracts, upon which contract price adjustments are based. The petroleum market was analyzed and an attempt was made to determine if there is one 'best' reference price or combination of reference prices that could be used in DFSC contracts. It was concluded that the 'best' reference price was a combination of crude oil posted prices. (Author)

32741 (EMD—77-53) **Oil company accounting practices.** Staats, E.B. (General Accounting Office, Washington, D.C. (USA)). 11 Jul 1977. 27p. Accounting Office, Washington, DC.

Portions of document are illegible.

A survey was made of accounting practices to show how they relate to cost and other financial information of two companies engaged in the domestic production of oil and natural gas. The two companies were: Shell Oil Company, a major integrated oil company which uses the "successful efforts" concept of accounting; and Houston Oil and Minerals Corporation, an independent producer of oil and natural gas which uses the "full-cost" concept of accounting. The accounting procedures used by these firms were studied to gain an understanding of the effects and rationale of the accounting procedures for accumulating financial data. Particular attention is given to the areas of interest, including the accounting issues regarding allocation of revenue and expenditures through time and allocation of revenue and expenditures among products.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33690, 33748

32742 (AD—839558) **Chemical treatment of oil spilled on harbor waters. Technical note.** Culbertson, T.L.; Scott, A.L. (Naval Civil Engineering Lab., Port Hueneme, Calif. (USA)). Aug 1968. 16p. (NCEL-TN—983). NTIS PC A02/MF A01.

Chemicals used to treat spilled oil in harbors are primarily emulsifiers that disperse the oil, rather than remove it from the water. As it requires a minimum of labor and specialized equipment, the chemical emulsifier treatment is often the least expensive method of quickly removing the fire hazard and surface pollution caused by spilled oil. However, as the oil remains in the water it may be harmful to marine life, and this method is, therefore, prohibited in some areas by conservation authorities. In an initial investigation of this procedure, fourteen chemical agents were tested to determine their effectiveness.

POLICY, LEGISLATION, AND REGULATION

32743 (EMD—78-24) **More attention should be paid to making the U.S. less vulnerable to foreign oil price and supply decisions.** Staats, E.B. (General Accounting Office, Washington, D.C. (USA)). 3 Jan 1978. 107p. Accounting Office, Washington, DC.

Report to the Congress by the Comptroller General of the United States.

A report is presented in which GAO recommends that the secretaries of State and Energy present to the Congress by July 1, 1978, a plan for improving security of U.S. imported oil supplies at reasonable prices by U.S. policy initiatives directed toward changes in access terms, incentives for production in other than OPEC countries, and bilateral and multilateral approaches to OPEC and other nations. Ultimately, this country, as well as the rest of the world, will become independent of oil. This is necessarily true because oil is a finite commodity and will run out someday. Accordingly, national attention ought to be directed to truly responsible concerns about how to achieve an orderly transition to an economy based upon alternative resources of energy. Today's policies must buy time and provide the petroleum supplies needed while other energy sources are developed and put in operation to replace them.

32744 (HRD—77-154) **U.S. oil companies' involvement in the International Energy Program.** Staats, E.B. (General Accounting Office, Washington, D.C. (USA)). 21 Oct 1977. 37p. Accounting Office, Washington, DC.

Report of the Comptroller General of the United States.

The Energy Policy and Conservation Act allows U.S. oil companies to participate in the International Energy Program, with Government monitoring to prevent anticompetitive activities. This report discusses that monitoring during a 1976 test of the Program's system to allocate oil during an emergency.

32745 **Oil and gas law. Volume 1. Creation and transfer of property interests.** Williams, H.R.; Meyers, C.J. New York; Matthew Bender and Company, Inc. (1977). 733p.

Includes supplement.

Volumes 1 and 2 present a comprehensive and systematic study of the creation and transfer of property interests in oil and gas. This volume covers: a brief introduction to technical background, nature of interests in oil and gas, classifications and consequences, conduct of operator injurious to others, problems of construction and conveyancing, adverse possession and trepass, oil and gas conveyancing, mineral-royalty distinction, conveyances by owners of fractional interests, and mineral interests. (DLC)

32746 **Oil and gas law. Volume 2. Creation and transfer of property interests.** Williams, H.R.; Meyers, C.J. New York; Matthew Bender and Company, Inc. (1977). 783p.

Includes supplement.

This volume, together with volume 1, is a comprehensive study of the creation and transfer of property interests in oil and gas. It covers: oil and gas conveyancing (part); royalty and nonexecutive mineral interests; term interests; the executive right; "subject to" clause; grants and reservations affecting working interest; assignments, partial assignments, and subleases; nonoperating interests; purchase letters, donation letters, farm-out agreements, and sharing arrangements; partnerships, mining partnerships, grubstake agreements, joint ventures, and business trusts; public regulation of conveyancing; constructive trust; concurrent interests; successive interests; other divided interests; apportionment of royalties; and drafting trusts, wills, and other dispositive instruments. (DLC)

32747 **Oil and gas law. Volume 3. Express clauses of oil and gas leases.** Williams, H.R. New York; Matthew Bender and Company, Inc. (1977). 873p.

Includes supplement.

This volume covers express provisions of oil and gas leases: habendum clause; drilling and rental clause; dry hole, cessation of production, and drilling operations provisions; shut-in royalty clause; royalty clause and related provisions; and granting clause and bonus provisions. (DLC)

32748 **Oil and gas law. Volume 4. Lease clauses, division orders, sales contracts.** Williams, H.R. New York; Matthew Bender and Company, Inc. (1977). 904p.

Includes supplement.

The volume is a continuation of express provisions of oil and gas leases begun in Vol. 3: provisions concerning operations; assignment, release, and surrender provisions; forfeiture and related provisions; title covenants; and pro rata provisions; other lease provisions; lease forms; division orders, transfer orders, and gas purchase contracts; and purchase and sale contracts. (DLC)

32749 **Oil and gas law. Volume 5. Implied covenants, express drilling obligations.** Williams, H.R.; Meyers, C.J. New York; Matthew Bender and Company, Inc. (1977). 659p.

Includes supplement.

This volume covers implied covenants in general, prudent-operator standard initial exploratory well covenant, implied drilling covenants, protection covenant, development covenant, further exploration covenant, marketing covenant, covenant to use reasonable care and diligence, effect of conservation laws on implied covenants, defenses and procedure in implied covenant litigation, and express drilling provisions.

32750 **Oil and gas law. Volume 6. Pooling and unitization.** Williams, H.R.; Meyers, C.J. New York; Matthew Bender and Company, Inc. (1977). 923p.

Includes supplement.

Pooling and unitization (of reservoirs) are forms of cooperative endeavors with the objective of efficient development of oil and gas reservoirs. After a separate treatment of pooling and unitization, this volume covers: provisions of pooling and unitization agreements and orders, voluntary pooling and unitization, compulsory pooling and unitization, effect of pooling and unitization on oil and gas leases, effect on term interests in oil and gas, problems common to compulsory and to voluntary pooled or unitized operations, operating problems, and fiduciary problems. (DCL)

32751 **Oil and gas law. Index volume. Manual of terms, table of cases, index.** Williams, H.R.; Meyers, C.J. New York; Matthew Bender and Company, Inc. (1977). 2353p.

Includes supplement.

This volume contains a manual of terms (glossary), a table of (legal) cases, and an index. (DLC)

PROPERTIES

32752 Exergy of the gaseous fuels and their combustion gases. Valent, V.; Djordjevic, B.; Radovanovic, D.; Malic, D. *Brennst.-Waerme-Kraft;* **29**: No. 11, 450-451(Nov 1977). (In German).

The article includes an investigation of the influence of the composition of the surrounding air on the exergy of the fuel, for 20 different gaseous fuels. In every case, it can be shown that this influence cannot be neglected; it amounts to 5 to 10% of the value of the exergy determined according to Z. Rant.

32753 High-pressure pVT data. Kuss, E. (Institut fuer Erdoelforschung, Hannover (Germany, F.R.)). *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **30**: No. 6, 273(Jun 1977). (In German).

32754 Determination of chloride salt concentrations in petroleum. Lobov, B.N.; Vinogradova, I.G.; Krupnik, V.B.; Kabardin, G.A.; Nigmatullin, R.M.; Molochuyi, V.B. (Gertsen Leningrad State Teacher's Inst., USSR). *Ind. Lab. (USSR) (Engl. Transl.);* **43**: No. 6, 764-765(Jun 1977).

Translated from Zavod. Lab.; 43: No. 6, 658-659(Jun 1977).

Emf measurements were used to determine the chloride content in aqueous extracts from petroleum. Accuracy was +- 3 mg/l for petroleum with salt content of 20 mg/l and +- 8.5 for petroleum with salt content of 600 mg/l. (DLC)

32755 Calculation of the chemical equilibrium and flame temperature of the ethylene-air-nitrogen system. Crescitelli, S.; Russo, G.; Tufano, V. (Univ di Napoli, Italy). *Riv. Combust.;* **31**: No. 7/8, 227-239(1977). (In Italian).

The interpretation of the experimental results obtained when studying the combustion of gases in closed vessels requires a knowledge of the thermodynamic properties of the burned gases. In particular, the adiabatic combustion pressure is needed to evaluate the laminar burning velocity, while an understanding of the extinction phenomena of flame kernels require a knowledge of the adiabatic flame temperature, the expansion ratio, and the composition of the burned mixture. These parameters may be evaluated on the basis of the hypothesis of thermodynamic equilibrium between the combustion products at constant pressure or volume. In this paper a computer program based on the Newton-Raphson iterative method for solving nonlinear systems of equations is presented. The mathematical analysis of the problem and some results obtained for the ethylene-air-nitrogen system are reported. The system was studied in the flammability range at various initial pressures (up to 20 atm) and temperatures (up to 600°K). 16 refs.

COMBUSTION

REFER ALSO TO CITATION(S) 33569, 33570, 33571

32756 (AD—045228) **Experimental scaling of modified fuel breakup. Interim report Jul 75—Nov 76.** Eklund, T.I. (National Aviation Facilities Experimental Center, Atlantic City, N.J. (USA)). Aug 1977. 27p. (FAA-NA—77-34). NTIS PC A03/MF A01.

A small-scale test configuration was developed for modified fuel breakup and ignition testing. The configuration consisted of a 1/4-inch fuel delivery tube within a 1-inch air atomization pipe followed by a deceleration cone. Photographic evaluation required design of a unique fuel spray photographic chamber which has the capability of photomicrographic, schlieren, and stroboscopic photographic techniques. The chamber employs positive pressurization with diluent air to prevent spray recirculation and fuel deposition on optical components. The spark photographs proved that the breakup phenomenon can be scaled down without obliteration of the dominant rheological effects. Motion pictures of ignition show the same flammability behavior shown in larger scale tests. It is concluded that the concentric tube atomization technique provides a practical method for comparative evaluation of modified fuels on a small scale.

32757 Corrosive effects of flue gas in supercritical boilers fired with heavy oils rich in sulfur. Magadeev, V.S. *Arch. Energiewirtsch.;* **31**: No. 8, 680-687(Aug 1977). (In German).

Flue gas corrosion was studied with the aid of the SO_2, SO_3 content and the corrosion rate. The sulfur content of the oil used was between 2.3 and 2.6%, the ash content between 0.08 and 0.1%. The process of sulfuric acid corrosion is mainly determined by acid condensation on the low-temperature heating surfaces. The highest corrosion rates occur on the peripheral sections of the regenerative preheater; futhermore, the corrosion rate is accelerated with increased ash deposition. With wall temperatures over 120°C in the sheet metal container of the air preheater, the corrosion rate is considerably reduced.

32758 Gas-phase oxidations of hydrocarbons. McKay, G. (Queen's Univ. of Belfast, Ireland). *Prog. Energy Combust. Sci.;* **3**: No. 2, 105-126(1977).

Various aspects of the oxidation of hydrocarbons in the temperature range 300 to 800°K have been considered. The characteristics of the combustion reactions have been reviewed with special attention to the unusual properties of cool flames. The theories of combustion have been summarized, and this work was followed by an investigation of such kinetic and thermochemical data as were available on alkyl radical-oxygen reactions. The data have been used to interpret and emphasize the important mechanistic trends in the field of hydrocarbon oxidation over a wide temperature range. While considerable progress has been made into understanding combustion theory, more kinetic information is required to interpret many of the combustion phenomena observed experimentally.

NATURAL GAS

RESERVES

REFER ALSO TO CITATION(S) 32713

GEOLOGY AND EXPLORATION

REFER ALSO TO CITATION(S) 32717, 32720, 32721, 32722

32759 (NVO/0655—102) **Western gas sands project status report.** (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). 1 Dec 1977. Contract EY-76-C-08-0655. 64p. Dep. NTIS, PC A09/MF A01.

The Western Gas Sands Project Plan, Project Implementation Plans, Project Plan Document FY 78 and the Quarterly Basin Activities Report are in various stages of preparation. Information gathering by the U.S. Geological Survey (USGS) of the initial data base for many of the project activities is continuing. Some base maps are complete and field investigations in the principal areas of interest are being conducted. Investigation of tight gas sands with scanning electron microscope, X-ray diffraction techniques and an X-ray spectrometer is proceeding. Research and Development by Energy Research Centers and National Laboratories funded by DOE has been directed toward the development of new tools and instrumentation systems, rock mechanics experiments, mathematical modeling and data analysis. The positive results of system development and data analysis techniques by Sandia and USGS/Menlo Park in determining fracture orientation have been very encouraging. The Field Test and Demonstrations section reports primarily on joint Government/Industry experiments. The Uinta Basin in Utah and Piceance Basin in Colorado have active massive hydraulic fracturing (MHF) experiments in the Upper Cretaceous tight gas formations. These are: Gas Producing Enterprises (GPE)—Natural Buttes No. 14, 18, 19, 20, 21, and 22; Mobil Research and Development—F-31-13G; and Rio Blanco Natural Gas.

DRILLING, PRODUCTION, AND PROCESSING

REFER ALSO TO CITATION(S) 32728, 32747

PRODUCTS AND BY-PRODUCTS

32760 (CONF-771228—1) **Analysis of the LNG industry.** Anderson, P.J.; Daniels, E.J. (Institute of Gas Technology, Chicago, Ill. (USA)). 1977. 23p. of Gas Technology, Chicago, IL.

From West coast LNG symposium; Nedlands, Australia (15 Dec 1977).

The two major segments of the LNG industry, peakshaving operations and base-load operations, are discussed to present an overview of the LNG industry, its technology, and its evolution. The expected growth in the base-load industry is also assessed.

32761 (CONF-780309—1) **LNG: its present and future utilization.** Anderson, P.J.; Daniels, E.J. (Institute of Gas Technology, Chicago, Ill. (USA)). 1978. 24p. of Gas Technology, Chicago, IL.

From Gas Processors Association convention; New Orleans, LA, USA (20 Mar 1978).

The two major segments of the LNG industry, peakshaving and base-load operations, are discussed to present an overview of the LNG industry. The current status of the base-load industry is reviewed, and its expected future growth is assessed with regard to

the status of each project and the construction schedules for project facilities. Based on these considerations, the total world LNG trade in 1985 is expected to be about 12.7 billion CF/day. The United States is expected to import about 6.8 billion CF/day in 1985. The pricing policies of exporting and importing countries are reviewed, as are LNG prices.

MARKETING AND ECONOMICS

REFER ALSO TO CITATION(S) 32741, 33262

32762 Marketing of gas in a household market against strong competition. Knapp, U. (Westfaelische Ferngas-A.G., Dortmund (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 562-567(Nov 1977). (In German).

From International symposium on the gas industry and environment; Minsk, USSR (20 Jun 1977).

Households in FRG can be regarded as an example for a gas market with strong competition from substitute sources of energy. In such a market it is important that the customer be made aware of the advantages that the use of gas offers as a source of heat energy in terms of investment expenditure and maintenance expense. Pollution-control regulations applying to the use of solid and liquid fuels must be stressed. It is shown what level the consumption of gas in households has reached in western Europe and what image gas enjoys as a form of heat energy in comparison with oil and electricity.

ARTIFICIAL STIMULATION, PLOWSHARE, ETC.

REFER ALSO TO CITATION(S) 32759, 33592

32763 (NVO/0677—1) **Massive hydraulic fracturing well, Federal No. 498-4-1, Rio Blanco County, Colorado. Final report.** van Poollen, H.K.; Ishteiwy, A.A.; Chancellor, R.E. (Rio Blanco Natural Gas Co., Denver, Colo. (USA)). Apr 1977. Contract EY-76-C-08-0677. 121p. Dep. NTIS, PC A06/MF A01.

This project is an MHF of a previously untreated Mesaverde interval in a well in northwest Colorado. The rocks involved may have been deposited during a marine invasion of long-continued, swamp environments. If so, they would have possessed superior primary reservoir properties. The logging program, identical to those used in the nearby Rio Blanco Nuclear and MHF Project wells, supplied contradictory information. The frac could furnish better understanding of the log suite, better parameters for pre-frac judgments of productive potential and further proof of the commercial capabilities of the formation. The frac job was performed as designed. A total of 775,000 lbs of sand in a total of 276,000 gallons of gelled water (YF4PSD) were injected. The injection pressures ranged from 2,000 to 1,300 psig at rates from 37 to 10 BPM. During the post-frac clean up, 30% of the frac fluid flowed back in 36 hours. Following eight days of swabbing and a total fluid recovery of 46%, the well began continuous flow, which within an additional three days brought total fluid recovery to 70%. Then gas flow increased from gas-cut water to 800 MSCF/D and declined to about 200 MSCF/D within 22 days. After over four months of production and cumulative frac fluid recovery of 82%, the gas rate appears to stabilize at around 130 MSCF/D with about 7 BF/D which contain over 50% oil. The post-frac to pre-frac production ratio is 2:1. It is concluded that revision of interpretive methods and/or logging programs is required if consistency in selecting zones most productive of gas and most receptive to stimulation is to be achieved. Injecting large volumes into short vertical intervals appears presently economically unattractive in this area. Properly designed moderate volume multiple fracs may achieve commercial deliverability.

32764 (UCRL—80360) **Some continuum considerations of the hydraulic fracturing process.** Hanson, M.E.; Shaffer, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Feb 1978. Contract W-7405-ENG-48. 12p. (CONF-780509—1). Dep. NTIS, PC A02/MF A01.

From 19. symposium on rock mechanics; Lake Tahoe, NV, USA (1 May 1978).

The hydraulic fracturing process has been the subject of analysis with newly developed two-dimensional theoretical numerical models. These models include descriptions of both the elastic continuum and porous flow fields which are coupled to permit study of the effects of pore pressure changes on the fracturing process. Three hydraulic fracturing problem areas have been the subjects of analysis with these models. These include (1) the observable surface deformation due to horizontal layering near a vertical hydrofracture. For layering which is defined by changes in the Poisson's ratio across the layer with constant Young's modulus in the medium, the positions of the maximum slope and deflections on the surface did not change much from the homogeneous case. On the other hand, changes in Young's modulus across the layers resulted in some change in the position of the maximum slopes and deflections. (2) The effects of changes in the pore pressure and thus the stress field around the fracture due to migration of the fracturing fluid into the material surrounding the fracture. The pore pressure effects are evidenced by a reduction in the compressive lobes adjacent to the fracture faces and a widening of the dilatational lobes surrounding the fracture tips as the pore pressure increases. The results also indicate that the stress intensity factors decrease as the pore pressure around the fracture increases. (3) The effects of layering on the stress field around the fracture. Here the elastic parameters can have a significant effect on the stress field around the fracture.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 32745, 32746, 32747, 32748, 32749, 32750, 32751

TRANSPORT, PIPELINES, AND HANDLING

32765 Interruptible supply of natural gas in Trier improves sales and utilization. Greim, O.; Lethen, H.; Schumacher, F. (Stadtwerke Trier (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 538-542(Nov 1977). (In German).

The experience gained by the Trier gas supply utility with interruptible contracts for the supply of natural gas must be regarded as very good. Such contracts help to make operations more economic and make supplies of natural gas more uniform. Normally the increasing use of gas for space heating results in a high demand in winter and thus to load fluctuations and, to a certain extent, in a deterioration in the number of operating hours. In the past few years this latter figure was kept around 250 hours per year. It is desirable politically and economically that the gas supply utility supplies local industries with energy at low cost. This is in keeping with the government's energy program which is aimed at increasing the use of natural gas. This helps to reduce the impact on the environment and ultimately results in energy savings since natural gas purchased at the price of work done is less expensive than oil. The improved revenue from sales finally yields decisive advantages for the gas supply utility. 6 figs., 4 refs., 1 table.

32766 Gas supply optimized through interruptible supply contracts and peak load plant. Haeberlin, A. (Ruhrgas A.G., Essen (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 532-535(Nov 1977). (In German).

Consumers in trade, industry and households expect the German gas supply industry to meet their demand fully at any time and in all seasons. Demand fluctuates for a number of reasons and the average number of operating hours for these customers is 3,000 hours per year when a continuous supply is maintained. In recent years it has not been possible to obtain additional supplies of imported gas for more than 7,000 or 8,000 hours per year. The German gas industry can only meet the demand if it is able to obtain the increasing quantities of imported gas in continuously. A suitable compromise must therefore be found to meet both the requirements of the consumer and of the supply industry. To overcome the difficulties interruptible supply contracts can be concluded and peak load plants built and operated. Which of the two solutions is feasible depends on the situation of the relevant gas supply utility. In the past ten years the German gas supply industry has demonstrated its ability to salve difficult problems. It will continue to do so provided competition is not distorted at its expense by public sector interference.

32767 Interruptible gas supply with on-line control. Helmer, K.E. (Siemens A.G., Saarbruecken (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 560-562(Nov 1977). (In German).

The experience gained by gas supply utilities has shown that the use of on-line computers for controlling the supply of gas to users with whom a contract for an interruptible supply was concluded helps to improve the utilization factor and to make supplies more uniform. The advent and low-cost manufacture of new and efficient electronic systems such as the micro-processor will make it possible to develop on-line procedures for starting and stopping gas supplies under interruptible supply contracts which can be proved to operate economically.

32768 Latest standards of pipeline construction technology. Volk, A. (Nordrheinische Erdgastransport G.m.b.H. (NETG), Haan (Germany, F.R.); Mittelrheinische Erdgastransport G.m.b.H. (METG), Haan (Germany, F.R.); Sueddeutsche Erdgas Transport G.m.b.H. (SETG), Haan (Germany, F.R.)). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 11, 484-490(Nov 1977). (In German).

After an explanation of the term 'pipeline construction', the author reports on present types of pipes and pipeline elements as well as on steel types to be used. The current construction technique is described, along with the welding techniques employed. Current test procedures, in particular pressure testing, are explained in some detail. Finally, the technical guidelines, regulations and ordinances valid in the FRG are mentioned.

32769 Interruptible gas supply. Mayer, E. (Hochbauamt der Stadt Heilbronn (Germany, F.R.). Maschinentechnische Abt.). *Gas Waerme Int.;* **26**: No. 11, 543-549(Nov 1977). (In German).

Whether an interruptible gas supply service is of interest for a public utility depends on the load conditions, the structure of the network and the demand of the customers. The author, however, also mentions the advantages which make interruptible gas supply contracts attractive to the gas user. Examples are cited to show why conversion to dual-fuel operation is advisable. Problems arising from such a conversion and connected with the shutting off of the supply and resumption of service are discussed.

32770 Interruptible gas supply to trade, industry, and municipalities. Zieting, D. (Landesgasversorgung Niedersachsen A.G., Hannover (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 535-537(Nov 1977). (In German).

The author outlines the criteria on which contracts for an interruptible gas supply are based and mentions the advantages thus offered to gas users. A number of examples are cited to show what can be achieved in practice. The sequence of shutoffs and resumptions of service is also dealt with.

COMBUSTION

REFER ALSO TO CITATION(S) 33569, 33571

32771 (IS—4329) Extraction and identification of organic materials present in soot from a natural gas flame. Vick, R.D.; Avery, M.J. (Ames Lab., Iowa (USA)). Jan 1978. Contract W-7405-ENG-82. 19p. Dep. NTIS, PC A02/MF A01.

Aliphatic and polynuclear aromatic hydrocarbons are readily extracted from soot formed from a natural gas flame using methylene chloride and ultrasonic agitation. Identification of 24 organic compounds via capillary column GC retention times and GC-MS data is reported along with details of experimental procedures.

OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 33251

OIL PRODUCTION, RECOVERY, AND REFINING

REFER ALSO TO CITATION(S) 33392

IN SITU METHODS, TRUE AND MODIFIED

32772 (SAND—77-1905) Compressor costs for true in situ oil shale retorting. Tyner, C.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 26p. Dep. NTIS, PC A03/MF A01.

Equipment and operating costs for the compressor facilities required for true in situ oil shale retorting are expected to be less than $2.50 per barrel of oil produced for formations with permeabilities of 10 darcys or more. These costs can be expected to rise, however, to between $10 and $17 per barrel for formations with permeabilities around 10 millidarcys. This dollar range is based on fifty percent resource recovery, 5 cents/kwh electric power, and the flow of air only (no liquid products) through the shale bed. Changes in these conditions (or others assumed in the calculations) will generally increase these costs.

SURFACE METHODS

32773 Electrical extraction of oil from tar sand. Vermeulen, F.E.; Chute, F.S. (Univ. of Alberta, Edmonton, Canada). *IEEE Trans. Ind. Appl.;* **IA-13**: No. 6, 604-607(1977).

A new technique for the separation of bitumen from tar sand is described. In this technique an electrical current is passed through a quantity of tar sand which is positioned in a vessel beneath a column of water. The passage of current causes the tar sand and the lower portion of the water column to become violently agitated and to eject particles of bitumen and sand. The bitumen particles rise to the surface of the water where they combine to form a froth. The sand particles rise only a short distance and then fall back towards the bottom of the vessel. Figures for energy balance and for the composition of the extracted bitumen and the tailings are given for laboratory scale experiments. The technique is compared to the commercially used hot-water separation process.

32774 Method for destructive distillation of hydrocarbonaceous materials. Putman, M.W. US Patent 4,075,083. 21 Feb 1978. Filed date 11 Jun 1976. 10p.

A method of retorting oil shale comprises the steps of passing the material in particulate form downwardly as a continuous vertical column of solid material successively through a preheating zone, a distillation zone, a combustion zone, and a residue cooling zone. An improved method of product oil recovery is disclosed whereby the vapor product is subjected to sequential treatment with cyclone separators and an absorption column, with a portion of the resulting noncondensible gases being recycled to the retort.

32775 Fluidized bed hydroretoring of oil shale. Gregoli, A.A. (to Cities Service Co.). US Patent 4,075,081. 21 Feb 1978. Filed date 20 Jul 1977. 8p.

Oil shale, crushed to about 70 mesh size (300 microns or less), is slurried with a recycle stream from the processing of the reactor effluent. The slurry is then heated and charged, along with hydrogen, to an upflow, fluidized bed reactor. The kerogen in the shale undergoes hydroretorting, giving a C_1—650°F range of products. The spent shale is removed with and separated from the reactor overhead effluent.

PURIFICATION

REFER ALSO TO CITATION(S) 33396

PROPERTIES AND COMPOSITION

32776 (LERC—3695-1) Laboratory evaluation of selected shale oil asphalts in paving mixtures. Report RF-3403-1. Button, J.W.; Epps, J.A.; Gallaway, B.M. (Texas Transportation Inst., College Station (USA)). Jan 1978. Contract EY-76-C-04-3695. 132p. Dep. NTIS, PC A07/MF A01.

Shale oil asphalt cements originating from the Green River formation in Colorado were characterized by laboratory tests commonly used in specifying paving asphalts. The asphalt cements were mixed with two common aggregates to fabricate laboratory specimens which were tested to identify paving mixture characteristics such as compactibility, stability, stiffness, tensile strength, and water susceptibility. Test results were compared to similar characteristics of a petroleum asphalt cement and petroleum asphalt-aggregate mixtures. Laboratory test results indicate no fundamental differences between shale oil asphalt and petroleum asphalt and furthermore properties of the mixtures are shown to be satisfactory when compared to standard specifications. 27 figures, 12 tables.

ENVIROMENTAL ASPECTS

32777 (PNL—2200) Ground disposal of oil shale wastes: a review with an indexed annotated bibliography through 1976. Routson, R.C.; Bean, R.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1977. Contract EY-76-C-06-1830. 179p. Dep. NTIS, PC A09/MF A01.

This review covers the available literature concerning ground-disposed wastes and effluents of a potential oil shale industry. Ground disposal has been proposed for essentially all of the solid and liquid wastes produced (Pfeffer, 1974). Since an oil shale industry is not actually in operation, the review is anticipatory in nature. The section, Oil Shale Technology, provides essential background for interpreting the literature on potential shale oil wastes and the topics are treated more completely in the section entitled Environmental Aspects of the Potential Disposal of Oil Shale Wastes to Ground. The first section of the annotated bibliography cites literature concerning potential oil shale wastes and the second section cites literature concerning oil shale technology. Each section contains references arranged historically by year. An index is provided.

NUCLEAR FUELS

REFER ALSO TO CITATION(S) 33224

RESERVES

32778 (GJBX—29(78)) **Distribution of calcretes and gypcretes in southwestern United States and their uranium favorability, based on a study of deposits in Western Australia and South West Africa (Namibia).** Carlisle, D.; Merifield, P.M.; Orme, A.R.; Kohl, M.S.; Kolker, O.; Lunt, O.R. (California Univ., Los Angeles (USA)). 6 Jan 1978. Contract EY-76-C-13-1664. 274p. NTIS, MF A01.

Portions of document are illegible.

Calcrete, dolocrete, and gypcrete carnotite are abundant in western Australia and Namib Desert, although only a few are of ore grade. The geology of these deposits are described. A genetic classification of calcretes emphasizing uranium favorability was developed, based on the distinction between pedogenic and nonpedogenic processes. Similarities between western Australia and South West Africa give support for the conclusions that lateral transport of U in groundwater is essential to ore deposition and that bedrock barriers or constrictions which narrow the channel of subsurface flow or force the water close to the land surface, greatly favor the formation of uraniferous calcretes. Criteria for uranium favorability deduced from the Australian and South West African studies were applied in a preliminary way to the southern Basin and Range Province of U.S. The procedure is to search for areas in which nonpedogenic calcrete or gypcrete may have developed. A caliche distribution map was compiled from soil survey and field data. Many areas were visited and some of the more interesting are described briefly, including parts of Clark County, Nevada, with occurrences of carnotite in calcrete. (DLC)

32779 (LA-UR—77-2796) **Search for other natural fission reactors.** Apt, K.E.; Balagna, J.P.; Bryant, E.A.; Cowan, G.A.; Daniels, W.R.; Vidale, R.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 15p. (CONF-771222—6). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

Precambrian uranium ores have been surveyed for evidence of other natural fission reactors. The requirements for formation of a natural reactor direct investigations to uranium deposits with large, high-grade ore zones. Massive zones with volumes approximately greater than 1 m^3 and concentrations approximately greater than 20 percent uranium are likely places for a fossil reactor if they are approximately greater than 0.6 b.a. old and if they contained sufficient water but lacked neutron-absorbing impurities. While uranium deposits of northern Canada and northern Australia have received most attention, ore samples have been obtained from the following worldwide locations: the Shinkolobwe and Katanga regions of Zaire; Southwest Africa; Rio Grande do Norte, Brazil; the Jabiluka, Nabarlek, Koongarra, Ranger, and El Sharana ore bodies of the Northern Territory, Australia; the Beaverlodge, Maurice Bay, Key Lake, Cluff Lake, and Rabbit Lake ore bodies and the Great Bear Lake region, Canada. The ore samples were tested for isotopic variations in uranium, neodymium, samarium, and ruthenium which would indicate natural fission. Isotopic anomalies were not detected. Criticality was not achieved in these deposits because they did not have sufficient ^{235}U content (a function of age and total uranium content) and/or because they had significant impurities and insufficient moderation. A uranium mill monitoring technique has been considered where the "yellowcake" output from appropriate mills would be monitored for isotopic alterations indicative of the exhumation and processing of a natural reactor.

32780 (LA-UR—77-2872) **2.05 x 10^9 age of the Oklo uranium deposit.** Gancarz, A.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 11p. (CONF-771222—2). Dep. NTIS, PC A02/MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

U and Pb isotopic data on samples (10 to 100 gram) 2 to 10 m away from the borders of the Oklo reactor zones indicate a primary age of 2.05 x 10^9 years for the Oklo deposit and a secondary age of 0.375 x 10^9 years. All samples show effects of Pb loss; the average loss is 50 percent. Both the U—Pb and Pb isotopic data are consistent with a model of a primary 2.05 x 10^9 year age of the deposit, continuous volume diffusion of Pb from uraninite, and either continuous or recent loss of this Pb. In this case the 0.375 x 10^9 year age is an artifact without time significance. Using an average value of D/a^2 3.5 x 10^{-11} a^{-1} (Cowan, this conference) this model explains the apparent 1.8 x 10^9 year Pb age observed by other workers. From the $^{208}Pb/^{206}Pb$ data the average U/Th value calculated for the Oklo deposit is approximately 100.

32781 **Crystallochemical differentiation and localization of uranium ore deposits in the Earth's crust.** Kostov, I. (Sofia Univ. (Bulgaria)). pp 15-29 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

Owing to its peculiar crystal chemistry uranium seems to have concentrated considerably during the formation of the earliest rocks making up the earth's crust. Mobilization and re-mobilization (often repeated) of this uranium with added minor uranium amounts, derived later from the mantle, provided the source for younger uranium ore deposits. The mobilization of uranium is triggered off by temperature gradients created mainly by tectonic processes. Uplifted protocontinental geoblocks and boundaries between them, as well as areas bordered by orogenic belts and geoblocks, seem to be the most favourable sites for uranium accumulation. Unconformities and permeable beds adjacent to crustal disruptions and evaporitic and petroliferous deposits are proper settings for uranium precipitation. Alkaline (mostly sodium) carbonate solutions and, less frequently, silicofluoride solutions, appear to transport the uranium in the earth's crust, although other compounds may play a similar role.

32782 **Orogenic and taphrogenic uranium concentration.** Gabelman, J.W. (Utah International Inc., USA). pp 109-119 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

Crustal compression at consuming plate boundaries, continental margins, or craton block junctions produces orogenic mobile belts of folding, thrusting, intrusion, metamorphism, and anatexis according to an asymmetric deformation gradient across the belt. Compression stimulates orogenic mineralization by remobilizing crustal metals, responding to a similarly oriented temperature paragenetic gradient, in a coincident zoned mineralization belt along the orogenic grain. Types of mobile and mineralization belts vary according to maximum deformation intensity. Low-intensity belts such as the Rocky Mountains are weakly or possibly not mineralized orogenically. Deep crust or mantle-generated tensional or wrench taphrogeny generates mineralization in belts enclosing grabens or horsts, wrench or transform faults, lineaments or linears or volcanic feeders. These form along or across orogenic mobile belts, in continental interiors, or in ocean basins. Metals may be juvenile from the mantle or remobilized from the crust. Strong mineralization belts diagonally across low-intensity orogenic belts suggest taphrogenic mineralization superimposed on much weaker orogenic mineralization. The Colorado and other northeast mineralization belts, including the broad northeast uranium belt of the western United States of America are examples. To determine which deformation type exerted stronger control over uranium distribution in this region, an isopycnic map of uranium occurrence density was prepared. The regional northeast uranium belt is sharply defined as composed of smaller belts enclosing or parallel to prominent taphrogenic features of several distinctive orientations. The weaker orogenic gradient is portrayed within the broad belt by the increase of uranium quantity toward a maximum near the Cordilleran foreland boundary.

32783 **Possible uranium mineralization in the light of recognized geological and geotectonic structures in Norway.** Lindahl, I.; Heier, K.S. (Geological Survey of Norway, Trondheim). pp 123-128 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The possibilities for uranium mineralizations in the geological setting of Norway, i.e. parts of the Baltic Shield and the Caledonian mountain belt, are discussed. Experience from the limited prospecting carried out so far is that the uranium concentrations in the Precambrian rocks increase towards the Caledonian front. The area along the Caledonian front, in both the Baltic Shield and the Eocambrian sediments, is regarded as favourable for uranium prospecting. The intersections of this geological discontinuity and large geotectonic lineaments, in addition to Precambrian discontinuities, are singled out as the most interesting prospecting objects. Some of the geotectonic lineaments have been mapped from ERTS photos.

32784 **Recognition of a favourable uraniferous area in sediments of Meghalaya, India. A case history.** Saraswat, A.C.; Rishi, M.K.; Gupta, R.K.; Bhaskar, D.V. (Department of Atomic Energy, Hyderabad (India). Atomic Minerals Div.). pp 165-182 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The Mahadeo Formation of the Cretaceous age in Meghalaya, India, has shown evidence of discrete uranium mineralization in a well-defined and readily identifiable stratigraphic zoning. The mineralization owes its origin to the highly radioactive source of Proterozoic Mylliem granites, and is invariably associated with coalified wood and carbonaceous matter in the arkosic strata, which belong to a marginal marine environment and form the base of a classical transgressive sequence. The favourability criteria and the formulation of exploration strategy have been examined in the light

of lithostratigraphy, facies equivalence, provenance environment, physiography, structure and climate.

32785 Features of the distribution of uranium in igneous rocks: uranium deposits associated with igneous rocks. Soerensen, H. (Copenhagen Univ. (Denmark)). pp 47-52 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The generally accepted main features of the distribution of uranium and thorium in igneous rocks are briefly reviewed. It is pointed out that uranium in most cases examined is strongly partitioned into the melt during consolidation of magmas and that uranium is concentrated in the most volatile-rich parts of magmas. The mode of emplacement and the consolidation of magmas control the retention or the expulsion of the volatile phase from consolidating magmas and also the distribution of uranium between magmas and the volatile phase. After a brief review of the types of uranium deposits associated with igneous rocks it is concluded that it is difficult to establish universally valid exploration criteria to be used in the search of these types of deposit. It is emphasized, however, that detailed petrological and geochemical studies may be useful in outlining exploration targets.

32786 (LA-tr—78-24) **Contribution of lead and thorium to the history of the Oklo reactors.** Devillers, C.; Menes, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1977. Translation of IAEA/TC—119-18. (CONF-771222—11). 21p. NTIS, PC A02/MF A01.

From IAEA symposium on natural fission reactors; Paris, France (19 Dec 1977).

The results of the measurement of lead and thorium on a series of samples representative of the uraniferous superconcentrations found in the mineralization of Oklo are presented. The interpretation of these data shows the complexity of the history of the lead in the deposit, and allows us to define some important facts: ancient disturbance, and recent and massive remobilization of the lead. We are led to believe that the date of the deposition of the uranium may be greater than 1900 million years. The absence of significant thorium contents in the "normal" rich ore confirms the interest of the determination of the date of nuclear reaction on the basis of the Th/U balance. This determination, which uses the same group of data as for the Nd/U balance, provides a similar average value: 1.93 billion years.

EXPLORATION

32787 (GJBX—2(78)(Vol.1)) **Aerial gamma ray and magnetic survey, Van Horn and Pecos Quadrangles, Texas. Volume I. Final report.** (GeoMetrics, Inc., Sunnyvale, Calif. (USA)). Oct 1977. Contract EY-76-C-13-1664. 138p. NTIS, PC E13/MF A01.

Portions of document are illegible.

A high sensitivity, airborne radiometric and magnetic survey of portions of the Big Bend, Texas area was conducted. The project area comprising the Van Horn and Pecos 1:250,000 NTMS sheets, consists of approximately 16,400 square miles. A total of 6,666 line miles of high sensitivity radiometric and magnetic data were collected. Traverse lines were flown at a spacing of 3.125 miles in an east/west direction with tie lines flown in a north/south direction at a 18.375 miles separation. All data were collected utilizing a fixed wing aircraft, Grumman G-89 and over 3,500 cubic inches of NaI crystal detector. Magnetometer data were collected utilizing a high sensitivity, 0.25 gamma, proton magnetometer. Data were digitally recorded at 0.5 second intervals. All field data were returned to the computer facilities for processing, statistical analysis, and interpretation. Other data are presented which include corrected profiles of all radiometric variables, magnetic data, radar altimeter data, barometric altimeter data, air temperature and airborne Bismuth contributions. Data presented have been summed to provide 1.0 second equivalent sample intervals, corrected for Compton Scatter, altitude dependence and atmospheric Bismuth. These data are presented in the form of strip charts, microfiche, and digital magnetic tapes containing raw spectral data, single record data, magnetic data, and statistical analysis results. In addition, computer generated anomaly maps along with interpretation maps are presented relating mapped geology to the collected radiometric data.

32788 (GJBX—16(78)) **NURE aerial gamma ray and magnetic reconnaissance survey, Thorpe area, Newark NK18-11 Quadrangle. Volume I. Narrative report.** (LKB Resources, Inc., Huntingdon Valley, Pa. (USA)). Nov 1977. Contract EY-76-C-13-1664. 108p. NTIS, PC E04/MF A01.

During the flying seasons of 1976 and 1977 LKB Resources, Inc. conducted a rotary wing combined airborne high sensitivity gamma-ray and magnetic survey of four 1:250,000 quadrangles covering portions of Pennsylvania, New Jersey, and New York. The airborne system, field operations, data reduction, gamma-ray and magnetic data presentation, geology and uranium deposits of the Thorpe Area, photogeologic enhancement study of the Thorpe Area, and data interpretation are discussed. (LK)

32789 (GJBX—24(78)) **Preliminary study of the uranium favorability of Mesozoic intrusive and Tertiary volcanic and sedimentary rocks of the Central Mojave Desert, Kern and San Bernardino counties, California.** Leedom, S.H.; Kiloh, K.D. (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Feb 1978. Contract EY-76-C-13-1664. 94p. Dep. NTIS, PC A03/MF A01.

Numerous, small, low-grade, supergene uranium deposits are found in Tertiary volcanic and sedimentary rocks in the central Mojave Desert of southern California. Large thorium-to-uranium ratios in samples of Mesozoic intrusive rocks exposed in the area indicate that these rocks have been extensively weathered, eroded, and subsequently leached by ground waters, and that they may have been the primary source of uranium for the deposits. The uranium content of samples of volcanic intrusive and extrusive rocks is average for intermediate to silicic rocks, but samples of basalt flows in the area contain six times the average uranium content of mafic igneous rocks. Devitrified tuffs and tuffaceous sedimentary rocks, interbedded with calcareous units, are additional sources of uranium for supergene uranium deposits found in calcareous units. Uranium is also found in accessory minerals in a few Mesozoic quartz-rich pegmatite dikes. Uranium deposits in the central Mojave Desert have been formed by enrichment during diagenetic replacement of Tertiary carbonate rocks; by supergene enrichment along fractures, joints, and bedding planes in Tertiary volcanic and sedimentary rocks; during formation of Holocene caliche; and by deposition within hydrothermally altered shear zones. Within the area, the diagenetic replacement type of deposit has the greatest potential for large, low-grade uranium occurrences. The other type of uranium deposits are small, erratically distributed, and extensively covered by alluvium.

32790 (GJBX—25(78)) **Preliminary study of uranium favorability of upper cretaceous, paleocene, and lower eocene rocks of the Bighorn Basin, Wyoming and Montana.** Hesse, S.L.; Dunagan, J.F. Jr. (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Feb 1978. Contract EY-76-C-13-1664. 45p. Dep. NTIS, PC A03/MF A01.

This report presents an evaluation of the uranium favorability of continental sediments of the Upper Cretaceous Lance, Paleocene Polecat Bench, and lower Eocene Willwood Formations in the Bighorn Basin of Wyoming and Montana, an intermontane structural basin of Laramide age. Previous work dealing with the Bighorn Basin was reviewed, and field investigations were carried out in the spring and summer of 1976. Subsurface data were collected and results of surface and subsurface investigations were evaluated with respect to uranium favorability. Precambrian plutonic and metamorphic rocks and Tertiary tuffaceous rocks in the Bighorn Basin and bordering uplifts are considered insignificant as source rocks, although the Wiggins Formation (White River equivalent) cannot be evaluated as a possible source because of a lack of data. Potential host rocks locally show only limited favorability. Lithology of strata exposed along the western and southern basin margins is more favorable than that of rocks in the central and eastern parts of the basin, but there is little organic material, pyrite, or other reducing agents in these rocks. Strata of the Lance, Polecat Bench, and Willwood Formations in the Bighorn Basin are considered generally unfavorable for sandstone uranium deposits.

32791 (GJBX—39(78)) **Preliminary study on uranium favorability of the Brushy Basin Member of the Morrison Formation, southeastern Utah and southwestern Colorado.** Dubyk, W.S.; Gallagher, G.L.; Edmond, C.L. (Bendix Field Engineering Corp., Grand Junction, Colo. (USA)). Mar 1978. Contract EY-76-C-13-1664. 20p. NTIS, PC E02/MF A01.

Geologic data were collected to evaluate the Brushy Basin Member of the Morrison Formation of Late Jurassic age as a potential source of uranium ore in southeastern Utah and southwestern Colorado. It was found that the member contains tuffaceous sediments that are an adequate source of uranium, mudstones that are favorable uranium host rocks, and reducing agents that favor the precipitation of uranium. Undiscovered uranium deposits in the Brushy Basin Member may be widespread and may represent appreciable potential resources of uranium ore. Most known deposits are in sandstone, but carbonaceous mudstones are more favorable for large deposits. Favorable areas for carbonaceous mudstone uranium deposits include the northern half of the San Rafael Swell and most of the western and northwestern borders of the project area. These locations correlate with the regional pinch-out of the Salt Wash fan and, specifically, with a paucity (<10%) of sandstone in the Brushy Basin Member. Recommended additional work includes an airborne radiometric survey, construction of net-sand maps, and detailed sedimentologic analysis of the Brushy Basin Member.

32792 (GJBX—48(78)) **Lawrence Livermore Laboratory hydrogeochemical and stream sediment reconnaissance. Raw data report: Roach Lake Basin orientation study, Kingman 1° x 2° NTMS area, Nevada.** Puchlik, K.P.; Holder, B.E.; Smith, C.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1977. Contract W-7405-ENG-48. 34p. (UCID—17681). NTIS, PC E02/MF A01.

This report presents the results of the Roach Lake Basin, Nevada, orientation study in the Kingman 1° x 2° quadrangle of the National Topographic Map Series (NTMS). Wet, dry, and playa sediment samples were collected throughout the 420 km² semi-arid, closed basin. Water samples were collected at the few available wells and springs. In addition to neutron activation analysis for uranium and 15 to 20 trace elements on all samples, field and laboratory measurements were made on water samples. Analytical data and field measurements are presented in tabular hardcopy and fiche format. Four full-size overlays for use with the Kingman NTMS 1 : 250,000 quadrangle are included. Water sample site locations, water sample uranium concentration, sediment sample site locations, and sediment sample total uranium concentration are shown on the separate overlays. A general description of the area and the rock type distribution is presented. Some of the data in this report have been issued previously in "Preliminary Report on the Roach Lake Pilot Study," GJBX-44(76), August 1976.

32793 Non-radiometric borehole geophysical detection of geochemical haloes surrounding sedimentary uranium deposits. Scott, J.H.; Daniels, J.J. (Geological Survey, Denver, Colo. (USA)). pp 379-389 of Exploration for uranium ore deposits. Vienna; IAEA (1976).

From International symposium on exploration of uranium ore deposits; Vienna, Austria (29 Mar 1976).

See CONF-760316—.

Roll-type uranium deposits are formed by the concentration of uranium by ground-water in geochemical cells. Non-uranium minerals having different solubilities may be deposited ahead of or behind the uranium minerals, forming haloes that surround the ore. In addition, oxidizing and reducing environmental conditions may cause zones of mineral alteration to develop beyond the limits of the uranium deposit. Certain physical property anomalies that are commonly associated with haloes can be detected by relatively fast and inexpensive borehole geophysical measurements made either in individual holes, or between two adjacent holes. Borehole measurements that have been found to be useful include electrical resistivity, induced polarization, and magnetic susceptibility. Electrical resistivity is increased by the presence of calcite and other cementing minerals that sometimes create permeability barriers in the neighbourhood of uranium deposits. Induced polarization (IP) response is increased by sulphide and clay minerals that are commonly found in anomalous concentrations near roll-type deposits. Magnetic susceptibility is usually decreased by the oxidation of magnetite to hematite or limonite in the zone of chemical alteration that is left as a trail behind roll fronts. Borehole measurements of electrical resistivity, induced polarization and magnetic susceptibility were made in the vicinity of a uranium roll-type deposit in south Texas. Results indicate that mineral haloes can be detected by borehole measurements made in wide-spaced drill holes, and that the total amount of drilling needed to find a deposit can be reduced substantially by this exploration approach.

32794 Sedimentary uranium occurrences in the Upper Carboniferous of the northern Black Forest. Ertle, H.J.; Kneuper, G.; Mueller, H. (Saarberg-Interplan Gesellschaft fuer Rohstoff-, Energie- und Ingenieurtechnik mbH, Saarbruecken, Germany, F.R.). pp 217-226 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The prospecting area lies between the Murgtal and the Rhine Graben and is characterized by a basinal structure. The Oos Basin is filled with sediments of Upper Carboniferous and Permian age. The Triassic Buntsandstein partially covers the Permian sediments. The possibilities for uranium prospection are based on the following geological characteristics: It is an isolated basin with relatively shallow deposited sediments of high permeability; interlayered claystone horizons protect the uranium enrichment horizons from possible leaching; and the debris of granites and rhyolites in the basin can be considered as uranium suppliers. Primary investigations led to the beginning of two investigatory tunnels in the Muellenbach Valley. In the meantime several other anomalies have been found in Upper Carboniferous and Rotliegende sediments, granites, rhyolites and even one in the Buntsandstein. In the Kirchheimer Tunnel five anomalies with values of greater than 100000 counts/min were found. The greatest uranium accumulation is bound in a fine- to middle-grained arkose-sandstone. Uranium appears as small lumps of pitchblende in siltstone and also diffusely concentrated in arkoses and claystones.

32795 Remote sensing in uranium exploration. Gabelman, J.W. (Utah International Inc., USA). pp 251-258 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

Remote sensing includes methods of detecting physical or chemical properties from a distance, but current usage and popularity in the natural resource community refer more to the NASA ERTS/LANDSAT program. Progress in conventional geophysics is documented elsewhere. Physicochemical remote detection of subatomic particles or ions emanated naturally or upon radiation stimulus from natural occurrences of uranium related elements is potentially useful. ERTS imagery refers mostly to multi-spectral scanner sensing from satellites of reflected electromagnetic radiations in the optical and near infra-red ranges. The other dominant aspect is conventional high-altitude photography. Images and photographs are of high quality, but each earth resource field has had to determine their usefulness empirically. Potential usefulness lies in the geometry of geological features seem simultaneously over larger areas with small features filtered as "noise" by greater distance, or in the recognition of distinctive geochemical features in the spectral data. Geometry, to be useful, requires acceptance of structural control over resource distribution. While rewarding in exploration for other metals, many uranium geologists not accepting structural control have not tried this method. To test applicability, linear geometry was interpreted from an image of the Grants uranium belt and compared with uranium distribution, resulting in good correlation. The geochemical aspects has been investigated searching for rock alteration patterns known to be critical to metal exploration. "Roll-front" alteration colours are useful in uranium search. This application has not proved significantly useful because the basic data-processing unit of images (pixel) is larger than the average size of geochemically distinctive geological units which are important in uranium geology.

32796 Distribution of radioactive elements and the recognition of uranium mineralizations in East Greenland. Nielsen, B.L.; Steenfelt, A. (Groenlands Geologiske Undersoegelse, Copenhagen (Denmark)). pp 87-101 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The Caledonian mountain belt and the bordering sedimentary formations in East Greenland are a geologically attractive exploration target for uranium. Because of difficult access and rugged topography the possible choices of prospecting methods are limited. A simple statistical treatment of data from an airborne gamma spectrometric survey has enabled potential source rock areas to be defined, e.g. Devonian granites and Devonian acid volcanics. A regional geochemical sampling programme supported and supplemented the results from the airborne survey. During a detailed helicopter and ground survey several types of uranium mineralizations were discovered indicating that uranium has been mobile within several geological environments.

32797 Recognition of uranium districts. Nininger, R.D. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Nuclear Fuel Cycle and Production). pp 1-10 of Recognition and evaluation of uraniferous areas. Vienna; IAEA (1977).

From Technical committee meeting on recognition and evaluation of Uraniferous areas; Vienna, Austria (17 Nov 1975).

See CONF-7511132—.

The present known uranium resources are inadequate for projected requirements beyond 1985. These resources should be soon enlarged by greatly increasing exploration efforts, the success of which will determine if the projected uranium demand can be met. Much additional work needs to be done to improve exploration techniques in uranium geology. The main hope of expansion rate of reserves lies in identifying entirely new uranium provinces and new types of high and intermediate grade deposits containing 100 to 700 ppm uranium. Very low-grade deposits - granites, most black shales, phosphate rock and sea-water - can provide, at best, only a fraction of world needs.

32798 Radiometric reporting methods and calibration in uranium exploration. Vienna; IAEA (1976). 57p.

Recommendations of a consultants' meeting on radiometric methods in uranium exploration are presented. After a short review of generally used methods (gamma spectrometry), special attention is given to the reporting and the calibration of radiometric measurements. Measurement units and terminology are considered. A new unit (unit of radioelement concentration) is proposed and recommended to be used for measurements of total radioactivity. Measurements made by gamma spectrometry are recommended to be reported in terms of dry weight radioelement abundance (% or ppm). The recommendations include the development of a standardized system

of reporting radiometric measurements and standardized methods for the calibration of instruments. Also the need for international calibration standards and analytical reference samples is considered. Finally, some recommendations for actions to be taken by the IAEA are given.

32799 Osnovy gamma-spektrometrii prirodnykh sred. (Fundamentals of gamma spectroscopy of natural media). Kogan, R.M.; Nazarov, I.M.; Fridman, Sh.D. Moscow; Atomizdat (1976). 368p.

The foundations of the application of gamma spectrometric methods to the study of natural formations are presented systematically. The structure, statistical and time fluctuations of the gamma field, the measurement of gamma radiation spectra, counting statistics and measurement errors, ways of identifying nuclides as well as the determination of the parameters of absorbing medium in laboratory, ground and aerial measurements are discussed. Progress in the theory and practice of field gamma-spectral methods is described and the efficiency of semiconductor detectors is evaluated. Particular methods of investigation are described, namely, the study of the space distribution and migration of uranium, thorium and potassium the application of gamma spectrometry to prospecting for useful minerals; the determination of levels of radioactive contamination of the environment with separate nuclides; the use of gamma radiation for hydrological purposes, such as the measurement of the snow cover of the upper layer of soil over large areas; the study of the radioactivity of the planets of the solar system.

FEED PROCESSING

32800 Recovery of uranium from sea-water. Llewelyn, G.I.W. (Economics and Programmes Branch, UKAEA, London). pp 205-212 of Uranium ore processing. Vienna; IAEA (1976).

From Meeting of the advisory group on uranium ore processing; Washington, DC, USA (24 Nov 1975).

See CONF-751192—.

The possibility of extraction of uranium from sea-water on a sufficiently large scale to contribute significantly to national UK requirements is placed in perspective. It seems unlikely that there are sites around the UK coast where this could be achieved, and insufficient work has been done to be confident that sites exist anywhere to enable uranium extraction to be carried out on a large scale. Process techniques have been developed on a small scale, but extensive further research work would be necessary to reduce appreciably the present uncertainties. It would be unwise to expect uranium from sea-water to contribute significant amounts to the world's uranium demand for thermal reactors on an acceptable timescale.

32801 Uranium from sea-water. Possibilities of recovery, exploiting slow coastal currents. Bettinali, C.; Pantanetti, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). pp 213-229 of Uranium ore processing. Vienna; IAEA (1976).

From Meeting of the advisory group on uranium ore processing; Washington, DC, USA (24 Nov 1975).

See CONF-751192—.

The authors analyse the interest in uranium recovery from sea-water within the framework of uranium world supply problems. The most reliable methods proposed for recovery are summarized and discussed, both from the chemical and the plant project points of view. Tides as a source of energy for water movement cannot be used in the Mediterranean and therefore only currents can be taken into account. The acceptable cost of an exchanger, in relation to the uranium price, is considered and related to known exchangers. The characteristics of exchanging elements are examined and the influence of the speed of sea currents discussed. The extractable uranium is a function of the exchange rate and of the speed of the flow inside the exchanging system; therefore it is quite clear that the current speed is not a prerequisite and that coastal currents around Italy are suitable. Exchanging elements built with sheets parallel to the flow, exchanging pans containing granular or fibrous exchangers have been considered. The main characteristics of a 1000 t/a plant are discussed considering different possibilities. The most acceptable seems to be the continuous extraction system. The parameters needed to calculate the dimensions of such a plant are given and the relation between the length and speed of the moving chain discussed. A rough economic evaluation of the plant cost - starting from known technologies - and of the final cost of the uranium oxide produced is made.

32802 Flotation process of lead-, copper-, uranium- and rare earth minerals. Broman, P.G.; Kihlstedt, P.G.; Du Rietz, C.D. (to Berol Kemi AB). US Patent 4,070,276. 24 Jan 1978. Priority date 15 Jan 1975, Sweden. 6p.

A process and flotation agents are provided for flotation of lead-, uranium-, and rare earth-type minerals and ores in which an aqueous pulp of the mineral or ore is subjected to a froth flotation, characterized in that the flotation is performed in the presence of a tertiary amine flotation agent. The process is especially applicable in the flotation of sulphide and oxide ores and minerals.

32803 Process development study on uranium-bearing carbonatite. Shabbir, M.; Naeem-ul-Zaman (Pakistan Atomic Energy Commission, University Town, Peshawar). pp 69-75 of Uranium ore processing. Vienna; IAEA (1976).

From Meeting of the advisory group on uranium ore processing; Washington, DC, USA (24 Nov 1975).

See CONF-751192—.

Mineralogical and chemical studies on uranium-bearing carbonatites showed the presence of apatite and calcite as major constituents. The presence of uranium in pyrochlore structure was suggested by X-ray diffraction studies. The average uranium content was of the order of 200ppM. The standard amenability tests indicated the refractory behaviour of the ore with respect to carbonate leaching. A 78% leaching recovery was achieved employing elevated temperature and pressure. The physical upgrading of the ore was possible using conventional gravity separation methods.

ENRICHMENT

REFER ALSO TO CITATION(S) 33583

32804 (KFK—2428) Experimental investigation of low temperature desublimation of uranium hexafluoride from mixtures with hydrogen using compact counter-current heat exchangers. Schmid, J.; Schuette, R. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Kernverfahrenstechnik). Apr 1977. 77p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

In separation nozzle cascades processing a mixture of UF_6 and hydrogen, a net upward transport of the light auxiliary gas is produced. To prevent enrichment of the light gas in the cascade, this upward flow has to be extracted from the top and fed back to the bottom of the cascade. In recycle facilities, the UF_6 content has to be stripped with high efficiency from the recycled hydrogen. This is done by using a special separation nozzle stage backed by a low temperature freeze-out heat exchanger system, which reduces the UF_6 content of the hydrogen from about 0.3% to values below 1 ppm. In freeze-out systems for UF_6 mixtures with Levis numbers higher than 1, snow formation as a result of inevitable supersaturation may severely reduce the efficiency of UF_6 stripping. With an experimental setup one seventh the cross-section of an industrial unit, the freeze-out process in a compact counter-current heat exchanger has been investigated to optimize the operation of the system. The desublimer passages are provided with serrated fins which maintain the gas flow in the initial stretch of the laminar and thermal transition zone. The experiments have shown that the theoretically expected improvement of mass to heat transfer by the ratio Le/Lesup(2/3), as compared to stabilized laminar flow, is actually obtained and no perturbations by snow formation are observed for supersaturation factors up to 1,000. The measured supersaturations of UF_6 are almost completely eliminated in the end cooler section within isothermal flow regions presenting sufficiently short diffusion distances. In all experiments starting with initial UF_6-concentrations in the range of 0.1...0.5 mol-% and with an end cooler temperature of -120°C, the UF_6 content in the hydrogen processed always ranged below the detection limit of 0.1 ppm UF_6 of the IR spectrometer used.

CENTRIFUGATION

32805 Cheaper enrichment attracts contracts. *Engineer (London);* 245: No. 6339, 54-55(22 Sep 1977).

The Urenco centrifuge cascade plant at Capenhurst for enriching uranium, has already attracted 1,000 million pounds worth of contracts. The plant and process are described briefly. (DLC)

LASER EXCITATION

32806 Method for separating isotopes from gaseous mixtures. Niemann, H.J.; Schuster, E.; Kersting, A. (to Kraftwerk Union AG). US Patent 4,072,590. 7 Feb 1978. Priority date 20 May 1974, German, Federal Republic of (F.R. Germany). 2p.

To separate isotopes from a gaseous mixture containing isotopes and a chemical reaction partner, the reaction between the partner and the isotope to be separated can be directed by a laser beam having a narrow band of wavelengths molecularly exciting the isotope to be separated. To maximize such an effect, the gaseous mixture is held inside of a laser cavity chamber with the cavity chamber providing at both ends with completely reflecting end plates, the laser being operated to form a reasoning wave which travels back and forth through the mixture.

32807 Method and apparatus for field ionization for isotope separation. Gallagher, T.F.; Hill, R.M.; Edelstein, S.A. (to Stanford

Research Inst.). US Patent 4,070,580. 24 Jan 1978. Filed date 17 Feb 1976. 8p.

Isotope separation method and means are shown, wherein an atomic beam containing two or more isotopes is exposed to radiation at a predetermined first wavelength to excite atoms of only one said isotope to a first intermediate excited state without substantially exciting atoms of other isotopes. These excited atoms are excited by a second radiation source at a second predetermined wavelength to a state of high principal quantum number, a Rydberg state, beneath the ionization continuum, again substantially without exciting atoms of said other isotopes to such high energy levels since substantially none of the other isotopes are in the intermediate excited state. From this bound atomic level only slightly below the ionization limit, the highly excited atoms are field ionized by electron tunneling and thence removed from the nonionized atoms by use of a moderate electric field.

FUELS PRODUCTION AND PROPERTIES

32808 Manufacture of nuclear fuel compacts. Leary, D.F.; Cooper, R.G.; Miertschin, G.N. (to General Atomic Co.). US Patent 4,064,204. 20 Dec 1977. Filed date 30 Sep 1974. 8p.

Nuclear fuel rods are manufactured utilizing a graphite flour-pitch matrix formulation containing an additive. The matrix formulation has a decreased viscosity at fabrication temperatures which permits manufacture of the fuel rods with lower fabrication pressures. Also, the matrix formulation does not cause the fuel rod to adhere or bond to the fuel element during heat treatment of the fuel rod in the fuel element. The nuclear fuel rods are suitable for use in high temperature gas cooled nuclear reactors.

32809 Pseudoplasticity of uranium dioxide. Evangelista, E.; Gondi, P.; Tognato, R. (Univ di Bologna, Italy). *Ceramurgia Tecnol. Ceram.;* **5**: No. 2, 73-77(1975). (In Italian).

High fracture loads have been obtained in the range from 600 to 800°C with microspheres of sintered UO_2 having small grain dimensions and limited porosity. The phenomenon is interpreted in terms of pseudoplasticity depending on zig-zag crack propagation from pore to pore along the grain boundaries.

SPENT FUELS REPROCESSING

REFER ALSO TO CITATION(S) 32820, 32821, 32822, 33226

32810 Atommuell oder der Abschied von einem teuren Traum. (Nuclear waste or the farewell to an expensive dream). Fischer, H.; Goedecke, R.; Herzer, W.; Kollert, R.; Poel, B.; Schmidt, P.G.; Schubert, W. (Bremen Univ. (Germany, F.R.). Fachsektion Physik). Reinbek, Germany, F.R.; Rowohlt (1977). 218p.

After the controversies over Wyhl and Biblis, Esensham and Brokdorf, resistance rises in the North of Germany against the planned nuclear waste factories. This book informs on problems and hazards in connection with reprocessing plants for spent fuel. It takes a critical look at the dangers of the 'peaceful' uses of nuclear energy and bids farewell to an expensive, and for everybody fateful dream.

TRANSPORT AND STORAGE

32811 (RHO-SA—40) Storage of spent unreprocessed fuel (SURF). Henry, K.H.; Turner, D.A. (Atomics International Div., Richland, Wash. (USA). Rockwell Hanford Operations). Mar 1978. Contract EY-77-C-06-1030. 17p. (CONF-780316—5). Dep. NTIS, PC A02/MF A01.

From Waste management fuel cycles; Tucson, AZ, USA (5 Mar 1978).

The following alternative storage concepts are discussed: sealed storage cask, dry well, and air-cooled vault. Technical evaluations of alternative storage concepts are given. (LK)

32812 Model optimizing spent nuclear fuel storage-capacity expansion. Kurstedt, H.A. Jr.; Nachlas, J.A.; Macek, V. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 113-119 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Annually, spent fuel from nuclear power plants must be deposited in on- and off-site temporary storage, awaiting governmental decisions on reprocessing and/or permanent disposal. Mathematical programming techniques are applied to a global model of the storage objective. The results indicate the time and location of additional storage capacity installation.

32813 Modeling the optimal management of spent nuclear fuel. Nachlas, J.A.; Kurstedt, H.A. Jr.; Swindle, D.W. Jr.; Korcz, K.O. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 127-133 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Recent governmental policy decisions dictate that strategies for managing spent nuclear fuel be developed. Two models are constructed to investigate the optimum residence time and the optimal inventory withdrawal policy for fuel material that presently must be stored. The mutual utility of the models is demonstrated through reference case application.

32814 Radioactive materials - Packagings - Tests for contents leakage and radiation leakage. Switzerland; ISO (1976). 3p. (ISO—2855-1976(E)).

This International Standard specifies methods for contents leakage and radiation leakage tests of prototypes of packages designed for transport of radioactive materials. For the contents leakage test, a description is given of the immersion tank required to perform the test, of the activity measuring instrument and of the test procedure. The radiation leakage test consists in a comparison of the measurement of radiation shielding efficiency performed before and after the physical and mechanical environmental tests. The measurement of radiation shielding efficiency may be performed by a radiographic or a radiometric method. Details of test equipment and procedure are described for both methods.

MARKETING AND ECONOMICS

32815 Outlook for uranium demand and production capacity. Rosenbaum, J.B. (Bureau of Mines, Salt Lake City, Utah (USA). Salt Lake City Metallurgy Research Center). pp 3-9 of Uranium ore processing. Vienna; IAEA (1976).

From Meeting of the advisory group on uranium ore processing; Washington, DC, USA (24 Nov 1975).

See CONF-751192—.

Despite appreciable errors in recent forecasts of nuclear power growth rate, the amended estimates still show the required amount of uranium raw material for 1985 to be three to four times larger than the world's existing uranium production capacity, both operating and on standby. By expanding the existing production units and adding new units based on known ore reserves, the uranium demands of 1980 might be met. The number of production units in the world (except for China, the Soviet Union and the Eastern European countries) might increase from the current 45 to about 70. Substantial additional capacity based mostly on newly discovered ore resources would be necessary to meet the uranium demands of 1985. Because a lead time of about eight years is probable to bring a newly discovered uranium deposit into production, a prompt increase in exploration activity is needed. The search for resources and development of reserves is expected to extend to ores containing as little as 0.02% U_3O_8 compared to the average ore grade of about 0.2% U_3O_8 now being processed. Expanded exploration activities require commensurate research and application effort to improve mining and milling practice for efficient and economical utilization of ores that are less accessible, of lower grade, or of different metallurgical response.

32816 National acquisition of sufficient know-how to determine procurement of natural and enriched uranium. Peix, J. (Compagnie Generale des Matieres Nucleaires (COGEMA), 92 - Chatillon (France)); Rougeau, J.-P. (Societe EURODIF, 92 - Bagneux (France)). *Ann. Nucl. Energy;* **4**: No. 6, 249-261(1977).

From Iran conference on transfer of nuclear technology; Persepolis/Shiraz, Iran (10 - 14 Apr 1977).

Today, the guarantees of a natural uranium supply and of its enrichment, seem to be the necessary conditions for assuring the development of nuclear electric program. However, decisions cannot be made before further consideration of the consequences it will have on the whole service of the nuclear fuel cycle. Whether the supplies are immediate, or medium term, or long term, the lead-times of the fuel cycle and the present situation of the world energy supplies are such that a country committed to develop nuclear electric energy must equip itself quickly with the indispensable human potential to define its own supply policy and then, to assure a strict achievement up to its interests. Thus, without forecasting any sort of policy, the first matter is to study the problems arising from nuclear fuel cycle and to propose a minimal human and technical potential, indicating the different stages of its constitution.

32817 Uranium supply and demand. Proceedings of an international symposium held by the Uranium Institute in London, June 15-17, 1976. Spriggs, M.J. (ed.). London; Uranium Institute (1976). 112p.p.

From International symposium on uranium supply and demand; London, UK (15 - 17 Jun 1976).

The symposium received and discussed papers on uranium production in South Africa, Australia, North America and other countries (excluding USSR, Eastern Europe and China) with substantial uranium resources, and on uranium demand. All aspects of the subject were covered, including the historical development of the uranium mining and production industry in the different countries, resources, forecasts of supply and demand, costs, prices, economics, and government policies in relation both to the control of production and to the development of nuclear power program.

WASTE MANAGEMENT

32818 Radioactive waste management: what you should know about. Lennemann, W.L. (International Atomic Energy Agency, Vienna (Austria)). *Engei Gakkai Zasshi;* **23**: No. 3, 19-21, 24-26(Mar 1977).

An overview is given of the nature and management of uranium mill tailings and various radioactive wastes. Illustrations are taken from Canadian programs, however the text is worldwide in scope.

WASTE PROCESSING

REFER ALSO TO CITATION(S) 32847

32819 (ARH-CD—915) **Ion exchange computer program for Zeolon 900 cation exchanger.** Gehrke, J.W. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 16 Mar 1977. Contract EY-76-C-06-2130. 25p. NTIS, MF A01.

Portions of document are illegible.

A computer program (CIXZE) has been developed to model Zeolon 900 ion exchange processes for study of the significant process variables. The program models the load, scrub, and elution cycle with four cations: cesium, sodium, potassium, and rubidium. Zeolon 900 equilibrium data is used in predicting the load, empirical data is taken into account in the scrub and elution models. The program has been tested and adjusted with B Plant Cesium Purification process data. During the period of most stable operation in 1975, the relation between the loading variables was accurately predicted. The scrub indicated realistic changes during a sensitivity study. Many of the process measurements had to be extrapolated to obtain the desired data due to the high ^{137}Cs concentrations in the system limiting the reliability of process sampling. The program was also tested with the proposed B Plant CAW process flowsheet. A critical judgment at this time is the loading capacity of the large Zeolon 900 column (T-18-2) in the flowsheet. Unfortunately data on the loading of Zeolon 900 with other cations (in the CAW feed) is not available at this time. Program results were helpful in the flowsheet design, however, optimization of the program with the CAW ion exchange process will be completed in conjunction with the pilot plant demonstration.

32820 (DP-MS—77-96) **Liquid waste handling facilities for a conceptual LWR spent fuel reprocessing complex.** Witt, D.C.; Bradley, R.F. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 33p. (CONF-780304—6). Dep. NTIS, PC A03/MF A01.

From ANS - The Back End of the LWR Fuel Cycle; Savannah, GA, USA (19 Mar 1978).

The waste evaporator systems and the methods for evaporating the liquid wastes of various radioactivity levels are discussed. After the liquid wastes are evaporated and nitric acid is recovered the high-level liquid waste is incorporated into borosilicate glass and the intermediate-level liquid waste into concrete for final disposal. (LK)

32821 (DP-MS—77-100) **Wiped-film evaporators for evaporating alkaline LWR radioactive wastes.** Goodlett, C.B. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 21p. (CONF-780304—7). Dep. NTIS, PC A02/MF A01.

From ANS - The Back End of the LWR Fuel Cycle; Savannah, GA, USA (19 Mar 1978).

Results are presented from tests at Savannah River Plant on using wiped-film evaporators for evaporating alkaline intermediate-level waste streams from the processing of spent LWR fuel. (LK)

32822 (ICP—1141) **Technical Division quarterly progress report, October 1—December 31, 1977.** Slansky, C.M. (ed.). (Idaho National Engineering Lab., Idaho Falls (USA)). Feb 1978. Contract EY-76-C-07-1540. 169p. Dep. NTIS, PC A08/MF A01.

Results are presented on the fluidized-bed calcination of simulated radioactive waste from the reprocessing of spent commercial nuclear fuel and on the removal of actinide elements from the waste prior to calcination. Other programs include the development of storage technology for ^{85}Kr waste; and the behavior of volatile radionuclides during the combustion of HTGR graphite-based fuel. The long-term management of defense waste from the ICPP covers post-calcination treatment of ICPP calcined waste; the removal of actinide elements from first-cycle raffinate; the retrieval and handling of calcined waste from ICPP storage vaults; and the preparation of the Programmatic Environmental Impact Statement on ICPP waste. Process improvements are reported on the Fluorinel headend process for Zircaloy-clad fuels and on uranium accountability measurements. Other development results cover the process for recovering spent Rover fuel, buried pipeline transfer systems, support to the Waste Management Program, Waste Calcining Facility support, New Waste Calcining Facility support, and effluent monitoring methods evaluation and development. In this category are studies on nuclear materials security, application of a liquid-solid fluidized-bed heat exchanger to the recovery of geothermal heat, inplant reactor source term measurements, burnup methods for fast breeder reactor fuels, absolute thermal fission yield measurements, analytical support to light water breeder reactor development, research on analytical methods, and the behavior of environmental species of iodine.

32823 (KFK—2446) **Description and starting of the VERA denitration plant.** Kartes, H.; Koschorke, H.; Kaufmann, F. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Abt. zur Behandlung Radioaktiver Abfaelle; Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). May 1977. 16p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

In the beginning of 1976 a plant for denitration of high and medium level fission product solutions has been set in inactive operation in the Karlsruhe Nuclear Research Center. The plant and its several components are presented. The operation and the start-up are described in detail. Also the methods of measurement important for controlling the process are explained. The procedure for denitration of medium level waste with a molarity of 1.5 is described in detail. In this connection a discussion of possible failures is included.

32824 (PNL—2265-1) **Research and development activities Waste Fixation Program. Quarterly progress report, January—March 1977.** McElroy, J.L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1977. Contract EY-76-C-06-1830. 66p. Dep. NTIS, PC A04/MF A01.

Research and Development activities of the Waste Fixation Program for January through March 1977 are described in this report. The objective of this program is to develop processes to convert high-level radioactive liquid waste (HLLW) to solid forms that are demonstrated to be physically, chemically, and radiolytically stable and inert. Several significant results were obtained during this reporting period.

32825 (RFP—2654) **Fluidized bed incineration system for U.S. Department of Energy defense waste. Status report, July—December 1976.** Richey, L.L.; Faccini, P.T.; Feng, P.K. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 27 Mar 1978. Contract EY-76-C-04-3533. 18p. Dep. NTIS, PC A02/MF A01.

A fluidized-bed incineration facility has been designed for installation at the Rocky Flats Plant. The purpose is to develop and demonstrate the process for the combustion of transuranic waste. The unit capacity will be about 82 kg/hr of combustible waste. The combustion process will utilize in situ neutralization of acid gases generated in the process. The equipment design is based on data generated on a pilot scale unit and represents a scale-up factor of nine. Title II engineering is complete and construction work has begun.

32826 (RFP—2708) **Secondary recovery of plutonium and americium from process waste streams by solvent extraction.** Hagan, P.G.; Navratil, J.D. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 16 Jan 1978. Contract EY-76-C-04-3533. 10p. (CONF-780305—11). Dep. NTIS, PC A02/MF A01.

From Division of fuel chemistry meeting; Anaheim, CA, USA (12 Mar 1978).

A solvent extraction process is being evaluated for the secondary recovery of plutonium and americium from Rocky Flats waste streams. The bidentate organophosphorus compounds dihexyl-N,N-diethylcarbamylmethylene phosphonate and its dibutyl analogue have been shown to be selective extractants for the actinides from solutions of nitric acid. The results from laboratory test runs in which the organophosphorus extractants were used for processing secondary waste solutions will be presented. Solvent extractant properties and purification procedures are discussed.

32827 Development of a laundry waste treatment system. Kikuchi, M.; Sugimoto, Y.; Yusa, H.; Ebara, K. (Hitachi Ltd., Ibaraki (Japan). Hitachi Research Lab.); Takeshima, M. (Hitachi Ltd., Ibar-

aki (Japan). Hitachi Works). *Nucl. Eng. Des.;* **44**: No. 3, 413-420(Dec 1977).

Fundamental and pilot plant experiments developed a laundry waste treatment system for nuclear power plants, consisting of a reverse osmosis unit for removal of radioactive materials and preconcentration, and an evaporator for the final concentration. A sponge ball cleaning method was employed for the reverse osmosis unit and a heat-resistant antifoam reagent for the evaporator. The pilot plant test, using simulated wastes, showed a decontamination factor of above 10^3 and a volume reduction ratio of 10^{-3}.

32828 Chemical digestion of low level nuclear solid waste material. Cooley, C.R.; Lerch, R.E. (to Energy Research and Development Administration, Washington, D.C. (USA)). Canadian Patent 991,861/A/. 29 Jun 1976. 8p.

A method is described for processing low level, light weight, bulky, combustible nuclear solid waste material comprising the steps of reacting said solid waste material with concentrated sulfuric acid at a temperature within the range of 230 deg - 300 deg C and simultaneously, subsequently, or both simultaneously and subsequently contacting said waste with concentrated nitric acid or nitrogen oxides whereby carbonaceous material is oxidized to gaseous byproducts and a low volume residue.

WASTE DISPOSAL AND STORAGE

32829 (BNL—50758) **Tritium storage development. Progress report No. 13, July—September 1977.** Colombo, P.; Johnson, R. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 30p. Dep. NTIS, PC A03/MF A01.

Engineering-scale operation was started on hydriding of zirconium for application to tritium storage systems. Eight runs were made with commercial-grade zirconium sponge at 338° to 499°C and 0 to 770 torr, hydrided to hydrogen-to-zirconium atom ratios up to 2. Reaction rates were determined for hydrogen flow rates of 2.72 to 9.24 cm^3 at STP/g Zr-min. For each run, hydrogen pressure was plotted on a semilog scale against time and H/Zr atom ratio to elucidate the reaction mechanism in terms of reaction kinetics, diffusion, and equilibrium hydrogen vapor pressure. Lack of consistency in some of the runs is probably due to difference in the extent of the diffusion barrier formed on the metal because of reaction with oxygen and other contaminants. Static leach testing of zirconium sponge and rod in distilled water was continued; leach rates ranged from 8.9×10^{-7} to 1.7×10^{-6} cm/day for the 166 to 208 day leach period.

32830 (RHO-ST—9) **Basalt waste isolation program. Annual report.** (Atomics International Div., Richland, Wash. (USA). Rockwell Hanford Operations). 30 Sep 1977. Contract EY-77-C-06-1030. 58p. Dep. NTIS, PC A04/MF A01.

This annual report provides information on the geotechnical and engineering studies undertaken to evaluate the suitability of using the Columbia River Basalt for long-term storage of nuclear waste. This research was conducted for the Office of Waste Isolation, Union Carbide Corporation, by the Department of Waste Isolation, Rockwell Hanford Operations. The work reported was accomplished during the period October 1976 through September 1977.

32831 (SAND—77-0378) **Thermoelastic capabilities for the SANDIA—BMINES program.** Tillerson, J.R.; Madsen, M.M. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1978. Contract EY-76-C-04-0789. 82p. Dep. NTIS, PC A05/MF A01.

The capability for simulating the thermoelastic behavior of geologic media has been added to the SANDIA-BMINES finite element code. The equations governing the response of a continuum to a known temperature field are delineated in this report. In addition, the specifics of the implementation of the continuum equations into the existing finite element program are described. Finally, the results of validation studies performed to assess the accuracy of the modified program are presentd along with recommendations concerning future research and development efforts in this field.

32832 (Y/OWI/TM—43/3) **Office of Waste Isolation progress report, December 1977.** Zerby, C.D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 31 Jan 1976. Contract W-8405-ENG-26. 74p. Dep. NTIS, PC A04/MF A01.

This document reports progress on the OWI's portion of the National Waste Terminal Storage (NWTS) program. It comprises project reports on work performed by organizations under subcontract to OWI, by DOE contractors, by OWI consultants, and by other federal agencies participating in the NWTS program. They are made under the headings technical projects, facility projects, planning and analysis, and regulatory affairs. (DLC)

32833 (Y/OWI/TM—43/4) **Office of Waste Isolation progress report, January 1978.** Zerby, C.D. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 28 Feb 1978. Contract W-7405-ENG-26. 74p. Dep. NTIS, PC A04/MF A01.

This document, prepared to report progress on the National Waste Terminal Storage (NWTS) program, consists of project reports on work performed by organizations under subcontract to OWI, by DOE contractors, by OWI consultants, and by other federal agencies participating in the NWTS program. The project reports are made under the headings technical projects, facility projects, planning and analysis, and regulatory affairs. (DLC)

32834 (Y/OWI/TM—45/10) **National Waste Terminal Storage Program. Progress report, July 1977.** Asher, J.M. (ed.). (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 1 Nov 1977. Contract W-7405-ENG-26. 71p. Dep. NTIS, PC A04/MF A01.

The report contains project reports on work performed by organizations under subcontract to OWI, by ERDA contractors, by OWI consultants, and by other federal agencies participating in the NWTS program. The reports are made under the headings of technical projects, facility projects, planning and analysis, and regulatory affairs. (DLC)

32835 (Y/OWI/TM—45/11) **National Waste Terminal Storage Program. Progress report, August 1977.** Asher, J.M. (ed.). (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 1 Nov 1977. Contract W-7405-ENG-26. 84p. Dep. NTIS, PC A05/MF A01.

Technical projects, facility projects, planning and analysis, and regulatory affairs are reported. (DLC)

32836 (Y/OWI/TM—53) **Executive summary of a draft report on the geology and salt deposits of the Salina Salt Basin.** (Union Carbide Corp., Oak Ridge, Tenn. (USA). Office of Waste Isolation). 3 Mar 1978. Contract W-7405-ENG-26. 25p. Dep. NTIS, PC A02/MF A01.

The study discussed is the first phase of a program for the geologic evaluation of the Silurian-age bedded salt of the Salina Group. The Salina Salt Basin, as used in this study, includes those portions of the Appalachian and Michigan basins that are underlain by the Salina Group. The full draft report consists of a regional reconnaissance, identification of study areas in New York and Ohio which are deserving of a more thorough evaluation, and a program plan to accomplish that evaluation. The entire draft report is in two volumes, contains 1068 pages and 204 figures, and has a bibliography that consists of over 1100 separate entries. This summary has been prepared for the benefit of those who wish to review the results of this phase of the evaluation but who do not want to go through the exhaustive detail that is present in the full report. The regional reconnaissance was accomplished by a very thorough and extensive literature review, addressing the following topics: depth of salt, thickness, stratigraphy, tectonics, structure, seismicity, hydrology, erosion and denudation, and mineral resources. Before further technical evaluation proceeds, the draft report and the proposed program are being subjected to a thorough evaluation by a number of groups, including appropriate state agencies. This rather extensive review process is being conducted to ensure that the program is performed entirely in the open and subject to continuous public surveillance. This report does not represent the first work that has been done in this region with regard to evaluating the salt deposits for waste disposal. Previous efforts have been limited, however, and have been done by individual consultants. At the present time, the U.S. Geological Survey is also participating in the technical evaluation; their results will be issued separately. In addition to the technical evaluations, environmental surveys will also be conducted as an integral part of this thorough evaluation program.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33758

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 33976

32837 Kritikalitaetssicherheit bei der Anwendung von Borosilicatglas-Raschigringen als Neutronenabsorber in Spaltstoffloesungen. Entwurf. (Criticality safety of borosilicate glass raschig ring as a neutron absorber in solutions of fissile material. Draft). Berlin, Germany, F.R.; Beuth (1977). 2p. (DIN—25421).

In the draft the requirements made on the Raschig rings and the solution containers are specified, and in-service tests and maximum admissible fissile material concentrations in the solutions stipulated. The standard draft is closely modelled on the American standard ANSI-N 164-1971.

REGULATIONS

ACCOUNTABILITY AND SAFEGUARDS

32838 (CEA-CONF—3908) **Fissile materials detection.** Dumesnil, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Mar 1977. 14p. (In French). (CONF-770390—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Electronics information meeting; Saclay, France (15 Mar 1977).

Description is given of three types of apparatus intended for controlling fissile materials in view of avoiding their diversion or preventing said products to be mixed to less dangerous radioactive wastes. The gantry-type apparatus is intended for the detection of small masses of fissile materials moving through a crossing place; the neutron gantry consists of helium 3 detectors of the type 150NH100, located inside polyethylene blocks; as for the gamma gantry, it consists of two large plastic scintillators integrated to the vertical legs of said gantry. The second apparatus is a high-efficiency detector intended for controlling Pu inside waste casks. It can detect 10mg of Pu inside a 100 liters drum for one minute counting. The third apparatus intended for persons and things monitoring is still on study; it is based on sampled measurement of the background noise.

32839 (SAND—78-8177) **Computerized transportation model for the NRC Physical Protection Project. Versions I and II.** Anderson, G.M. (ORINCON Corp., La Jolla, Calif. (USA)). 23 Feb 1978. Contract EY-76-C-04-0789. 168p. (OC-R—77-87-9964-3). Dep. NTIS, PC A08/MF A01.

Details on two versions of a computerized model for the transportation system of the NRC Physical Protection Project are presented. The Version I model permits scheduling of all types of transport units associated with a truck fleet, including truck trailers, truck tractors, escort vehicles and crews. A fixed-fleet itinerary construction process is used in which iterations on fleet size are required until the service requirements are satisfied. The Version II model adds an aircraft mode capability and provides for a more efficient non-fixed-fleet itinerary generation process. Test results using both versions are included.

32840 **Checks on fissile materials from the point of view of the IAEA.** Heger, H. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Muehlheim-Kaerlich (Germany, F.R.). Abt. Physik). *At. Strom;* **23**: No. 4, 87-89(Jul 1977). (In German).

During a course on national organisation of fissile material supervision the IAEO gave in May/June of this year a review of its own ideas and requirements for the system by which the safety measures can be made possible, and than into practice, in accordance with Article III of the Treaty banning atomic weapons.

32841 **Nuclear energy between non-proliferation and necessity. Salzburg Conference of the IAEA on nuclear energy and its conversion cycle.** Braatz, U. (Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (Germany, F.R.)). *At. Strom;* **23**: No. 4, 85-87(Jul 1977). (In German).

From International conference on nuclear power and its fuel cycle (commemorating the 20. anniversary of IAEA); Salzburg, Austria (2 - 13 May 1977).

The author gives a review of the most important aspects of this conference.

32842 **LAEA's activities in safeguarding nuclear materials and in developing internationally acceptable safety codes and guides for nuclear power plants.** Rometsh, R.; Specter, H. (International Atomic Energy Agency, Vienna (Austria)). *Ann. Nucl. Energy;* **4**: No. 6, 329-335(1977).

From Iran conference on transfer of nuclear technology; Persepolis/Shiraz, Iran (10 - 14 Apr 1977).

The activities and progress of the IAEA in developing and implementing a system for safeguarding nuclear materials against diversion from peaceful purposes are described. The various services provided by the Agency in the field of nuclear safety are discussed. Basic Safety Standards for radiation protection and specialised regulations and codes of practice on specific types of operations constitute the Agency's Safety Standards. In addition nuclear Safety Codes of Practice and Safety Guides are being developed in the following areas: governmental organisations, siting, design, operations, and quality assurance to assist countries in establishing their nuclear safety regulations.

32843 **Safeguards Against Nuclear Proliferation.** Stockholm; Almqvist and Wiksell (1975). 1-114p.

International safeguards to ensure that nuclear materials and equipment will not be used to further any military purpose were established almost simultaneously with the first exchanges in this field. The basic purpose of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) is to maintain a political balance in the world by preventing an increase in the number of nuclear-weapon States, without impeding development of the peaceful uses of nuclear energy. This book analyzes the NPT provisions in detail, and examines, in the frame of the International Atomic Energy Agency, the practical problems raised by its application.

32844 **Nuclear Age.** Stockholm; Almqvist and Wiksell (1974). 1-148p.

This is the third book on nuclear matters published by the Stockholm International Peace Research Institute (SIPRI). It deals with utilization of nuclear energy and its spread, the nuclear fuel cycle, nuclear safeguards and nuclear explosions for peaceful purposes. These data were intended to serve as basic information and proposals for the Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) held in Geneva in May 1975. The Appendices contain information on NPT ratifications and IAEA Safeguards Agreements.

FUSION FUELS

PROCESSING

FABRICATION AND TESTING

32845 (LA—7167-MS) **Double-shell target designs for the Los Alamos Scientific Laboratory eight-beam laser system.** Kindel, J.M.; Stroscio, M.A. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 15p. Dep. NTIS, PC A02/MF A01.

We investigate two double-pusher laser fusion targets, one that incorporates an outer exploding pusher shell and another that uses velocity multiplication. Specific designs are presented for the Los Alamos Scientific Laboratory Eight-Beam Laser System.

32846 (UCRL—80209) **Automated laser fusion target production concept.** Hendricks, C.D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Oct 1977. Contract W-7405-ENG-48. 5p. (CONF-780202—16). Dep. NTIS, PC A02/MF A01.

From Topical meeting on inertial confinement fusion; San Diego, CA, USA (7 Feb 1978).

A target production concept is described for the production of multilayered cryogenic spherical inertial confinement fusion targets. The facility is to deliver targets to the reactor chamber at rates up to 10 per second and at costs consistent with economic production of power.

BY-PRODUCTS

REFER ALSO TO CITATION(S) 32852

WASTE MANAGEMENT

32847 **Evaluation of fusion reactor transmutation for management of strontium from fission reactors.** Parish, T.A. (Texas Univ., Austin). pp 1166-1171 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

One proposed method to reduce the final disposal hazard potential of fission reactor wastes is transmutation in fusion reactors. This study deals specifically with ^{90}Sr which composes 98 percent of the iniitial waste toxicity. A transmutation-based waste management program was formulated and a computer code was written to investigate the ^{90}Sr inventories for various fission reactor usage and burner reactor deployment scenarios. Three fission energy generation schemes were evaluated: (1) moderate growth to 400 fission reactors in 2005 then constant thereafter, (2) high fission growth to 630 1000 MW reactors in 2005 and then further growth to 1500 1000 MW reactors in 2055, and (3) continued high fission growth to peak at 2025 and then decline. Elemental strontium was employed as the transmutation target, and thus it was not necessary to employ a laser enrichment step in the waste management program. Blanket calculations were performed for a TOKAMAK burner reactor which produced 5685 MW/sub th/. The material flow for the transmutation-based waste management program assumes a one year period for cool down of the spent fission reactor fuel and chemical removal of the strontium from the other high level wastes. The strontium is then loaded into fusion burners and irradiated for 2 years. After irradiation, all strontium is extracted and recycled back through reprocessing. Chemical separation efficiencies are assumed and

wastes from these processes are placed into a final disposal inventory. With transmutation the ^{90}Sr inventory is reduced to about 40 percent of the inventory if no transmutation were to occur. For a more advanced burner reactor (50 MW/m^2) the total ^{90}Sr inventory is reduced to about 15 percent of the no transmutation value. A final evaluation of such a transmutation program should also include a study of possible accidental releases and plant economics.

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

PHYSICAL ISOTOPE SEPARATION

HEAVY WATER PRODUCTION

32848 Interconnection arrangement for a dual temperature isotope exchange. Pauluis, G.J.C.A. (to Atomic Energy of Canada Ltd.). US Patent 4,072,469. 7 Feb 1978. Priority date 9 Sep 1975, Canada. 6p.

An interconnection arrangement for a dual temperature isotope exchange process of the type having a first stage made up of a cold tower, a hot tower, a humidifier and a dehumidifier with a recycled gas stream passing in countercurrent isotope exchange relationship with a liquid stream in the said towers and a similar second stage, said first stage having heat exchange means between humidifier and dehumidifier formed of humidifier and dehumidifier recycle loops passing through a heat exchanger, the improvement comprising means for feeding a portion of the liquid passing in the dehumidifier recycle loop of the first stage to the top of the humidifier of the second stage, means for feeding the liquid passing through the humidifier of the second stage back to the dehumidifier recycle loop of the first stage, and means for passing a portion of the liquid from the first stage in heat exchange relationship with the liquid in a dehumidifier recycle loop of the second stage.

RADIATION SOURCES

REFER ALSO TO CITATION(S) 33651

DESIGN AND FABRICATION

32849 (SAND—77-1845C, pp 668-669) **Analyzing randomly occurring voltage breakdowns.** Wiltshire, C.W. (General Electric Co., St. Petersburg, FL). 1977.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

In Proceedings of the digital signal processing symposium.

During acceptance testing of high-vacuum neutron tubes, 40% of the tubes failed after experiencing high-voltage breakdowns during the aging process. Use of a digitizer in place of an oscilloscope revealed two types of breakdowns, only one of which affected acceptance testing. This information allowed redesign of the aging sequence to prevent tube damage and improve yield and quality of the final product. (RWR)

OTHER INDUSTRIAL USES

REFER ALSO TO CITATION(S) 32937

ISOTOPIC POWER SUPPLIES

DESIGN AND FABRICATION

32850 (BMI-X—691) **Heat source component development program, October 1977—February 1978.** (Battelle Columbus Labs., Ohio (USA)). Mar 1978. Contract W-7405-ENG-82-094. 51p. Dep. NTIS, PC A04/MF A01.

The General Purpose Heat Source (GPHS) is being developed by Los Alamos Scientific Laboratory (LASL) for the Department of Energy (DOE) Division of Nuclear Research and Application (DNRA). The first mission scheduled for the GPHS is the NASA Out-of-Ecliptic Flight in January, 1983. During the current reporting period (October—December, 1977, January—February, 1978), activities in this task were conducted as follows: (1) documentation of results of the reentry thermal, ablation, and thermal stress analyses of the conceptual designs; (2) identification and completion of modifications to the thermal and ablation models used to determine the performance response of the heat source modules during reentry; (3) initiation of modifications to the thermal stress model used to determine the performance response of heat source modules during reentry; (4) completion and documentation of the surface chemistry experiments; (5) initiation and completion of activities in support of LASL to define test plans for the trial design phase of the GPHS development program; (6) participation in the GPHS design review meeting held at DOE/Germantown, Maryland, December 19—20, 1977; and (7) initiation of the thermal analysis of Trial Design 1.1.

HYDROGEN

32851 (AD—045281) **Hydrogen technology-foreign.** Busi, J.D. (AN SSSR, Moscow. Fizicheskij Inst.). May 1976. 141p. NTIS PC A07/MF A01.

This technical trend study is intended to provide US military planners and research and development organizations with a comprehensive analysis and description of foreign advancements in the field of hydrogen technology. It emphasizes developments in both free world and Eurasian Communist countries with significant research and development programs. The study contains a detailed explanation of the various phases of hydrogen technology, an assessment of the current state-of-the-art, and long-range (20- to 30-year) forecast reflecting future commercial and military capabilities and applications.

PRODUCTION

ELECTROLYSIS

REFER ALSO TO CITATION(S) 32855

32852 (COO/0016—01) **Fusion reactors-high temperature electrolysis (HTE).** Fillo, J.A. (ed.). (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1978. Contract EY-76-C-02-0016. 133p. Dep. NTIS, PC A07/MF A01.

Results of a study to identify and develop a reference design for synfuel production based on fusion reactors are given. The most promising option for hydrogen production was high-temperature electrolysis (HTE). The main findings of this study are: 1. HTE has the highest potential efficiency for production of synfuels from fusion; a fusion to hydrogen energy efficiency of about 70% appears possible with 1800°C HTE units and 60% power cycle efficiency; an efficiency of about 50% possible with 1400°C HTE units and 40% power cycle efficiency. 2. Relative to thermochemical or direct decomposition methods HTE technology is in a more advanced state of development, 3. Thermochemical or direct decomposition methods must have lower unit process or capital costs if they are to be more attractive than HTE. 4. While design efforts are required, HTE units offer the potential to be quickly run in reverse as fuel cells to produce electricity for restart of Tokamaks and/or provide spinning reserve for a grid system. 5. Because of the short timescale of the study, no detailed economic evaluation could be carried out.A comparison of costs could be made by employing certain assumptions. For example, if the fusion reactor-electrolyzer capital installation is $400/(KW(T) [$1000/KW(E) equivalent], the H_2 energy production cost for a high efficiency (about 70 %) fusion-HTE system is on the same order of magnitude as a coal based SNG plant based on 1976 dollars. 6. The present reference design indicates that a 2000 MW(th) fusion reactor could produce as much at 364 x 10^6 scf/day of hydrogen which is equivalent in heating value to 20,000 barrels/day of gasoline. This would fuel about 500,000 autos based on average driving patterns. 7. A factor of three reduction in coal feed (tons/day) could be achieved for syngas production if hydrogen from a fusion-HTE system were used to gasify coal, as compared to a conventional syngas plant using coal-derived hydrogen.

WATER GAS PROCESSES

32853 Method for the conversion of carbon monoxide and steam into hydrogen and carbon dioxide. Riley, K.L.; Aldridge, C.L. (to Exxon Research and Engineering Co., Linden, N.J. (USA)). German(FRG) Patent 2,463,784/A/. 28 May 1975. 29p. (In German).

The conversion of carbon monoxide and steam to hydrogen and carbon dioxide is carried out on a catalyst consisting of an alkali salt of a weak acid and a hydrogenation/dehydrogenation component. The latter may either be a noble metal material (ruthenium, palladium, osmium, iridium or platinum) or a non-noble metal material (vanadium, molybdenum, tungsten or cobalt). A sulfidized mixture of cobalt and molybdenum materials, particularly suitable for the use of sulfur-contaminated gas mixtures, is preferred. In order to obtain a maximum catalyst efficiency, the steam carbon monoxide mixture is brought into contact with the catalyst at a temperature of between 17 and 39°C above that of the mixture's thaw point. The catalyst activity is improved by putting the components onto a

porous carrier in which at least 50% of pore volume is formed of pores having a diameter of more than 100 A. Degrees of conversion of carbon monoxide of over 99% are achieved.

PARTIAL OXIDATION PROCESSES

32854 Method to separate soot from the washing-water circuit of hydrogen-containing synthesis gas, produced by the partial oxidation of hydrocarbons. Giesen, H.; Hibbel, J.; Jansen, W.; Speth, S. (to Ruhrchemie A.G., Oberhausen (Germany, F.R.)). German(FRG) Patent 2,440,473/B/. 27 Nov 1975. 4p. (In German).

In order to separate soot from soot-water suspensions as occur when removing soot from synthesis gas produced by the partial oxidation of hydrocarbons, the thick oils which occur as by-products in the oxo-synthesis are used. The hardly volatile residue termed thick oil essentially consists of higher alcohols, aldehydes, acetalene, carbonic acids and esters. When mixed together with the soot-water suspension in a decanter, a soot-thick oil and a water phase are formed which contains less than 0.5 wt.% thick oil and after separation of the soot washing, is recycled. The soot-thick oil suspension in a plate separator is split up into an enriched phase (soot content: 10-15%) and a cleared phase: (soot content: 0.3%). The enriched phase is mixed with initial oil and added to the gasification reactor. The cleared phase is recycled into the decanter.

STORAGE

CHEMISORPTION

REFER ALSO TO CITATION(S) 33393

32855 (BNL—23926) **Electrolysis-based hydrogen storage systems overview and rationale of the Brookhaven National Laboratory managed program.** Salzano, F.J. (Brookhaven National Lab., Upton, N.Y. (USA)). [nd]. Contract EY-76-C-02-0016. 3p. Dep. NTIS, PC A02/MF A01.

The rationale for determining program direction, emphasis, and allocation of resources is presented. The rationale has been developed through interaction with the hydrogen research and development community and in light of information available on competing energy systems and on-going systems studies.

32856 Hydrogen absorption on intermetallic compounds. de Pous, O.; Lutz, H.M. (Battelle Inst., Geneva). pp 8p, Paper 1E8 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Several intermetallic compounds absorb a large amount of hydrogen. The occurrence of hydride formation can be correlated to interatomic distances and electron density which are characteristic of the structure and the stability of the initial intermetallic compound.

32857 Properties of FeTi-hydrides used for hydrogen storage. Lebsanft, E.; Arnold, G.; Klatt, K.H.; Pick, M.A.; Toepler, J.; Wenzl, H. (Festkoerperforschung, Juelich, Ger.). pp 7p, Paper 1E10 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The development of a hydrogen storage container for laboratory use is dealt with as well as the diffusion of hydrogen in FeTi and the heat of solution as relevant physical properties for hydrogen storage in FeTi.

32858 Rare earth ternary hydrides. Hydrogen storage applications. Achard, J.C.; Percheron-Guegan,←, A.; Diaz, H.; Briaucourt, F.; Demany, F. (CNRS, Meudon, France). pp 6p, Paper 1E12 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The hydrogen sorption properties of $LaNi_5$ type compounds in which La or Ni are gradually replaced by Yb, Ca, Mg, Ti and In, Al, Cu are determined by solid gas reaction. These properties are related to the structural properties of intermetallic compounds. The use of these compounds for electrochemical application and isotopic separation is presented.

TRANSPORT

REFER ALSO TO CITATION(S) 32863

32859 Hydrogen - a potential energy carrier of the future. Keller, C. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Schule fuer Kerntechnik). *Chem. Ztg.;* **101**: No. 5, 223-240(May 1977). (In German).

According to its excellent specific properties - e.g., high energy content, very good environmental aspects, good storage and transport properties -, hydrogen is generally regarded as energy carrier of the future. Corresponding to electricity, hydrogen is no primary energy carrier, but a secondary one - large amounts of other forms of energy are needed to produce hydrogen via water splitting. Therefore, the future of the 'hydrogen energy' will strongly depend on improved and less energy consuming methods for large scale production. This review will give a critical description of the present status of 'hydrogen economy' and its future prospects. Special attention is given to the possibility and necessity of improved and cheap hydrogen production, especially by using thermocycle cycles with the background of heat delivering by nuclear high temperature reactors.

SAFETY

32860 Detonation of tubular explosives in liquid hydrogen. Sil'vestrov, V.V.; Urushkin, V.P. (Inst. of Hydrodynamics, Novosibirsk, USSR). *Fiz. Goreniya Vzryva;* **13**: No. 1, 78-84(1977). (In Russian).

The causes of increased detonation velocity of tubular charges with a liquid-hydrogen filled cavity were investigated for a number of explosives with fulmination thresholds of from 2 to 25 kbar. The gas flow emerging in the bore exceeds the normal detonation velocity and causes the formation of a side conical compression wave in the explosives which significantly influences the nature of the detonation process.

INDUSTRIAL AND COMMERCIAL USE

REFER ALSO TO CITATION(S) 33315, 33322, 33359, 33393, 33394

PROPERTIES

REFER ALSO TO CITATION(S) 33439, 33459

OTHER SYNTHETIC AND NATURAL FUELS

PROPERTIES

32861 Development of disturbances on the surface of a flame propagating from a central ignition point source in a closed vessel. Gussak, L.A.; Istratov, A.G.; Librovich, V.D.; Sprintsina, E.N. (Inst. of Chemical Physics, Moscow). *Fiz. Goreniya Vzryva;* **13**: No. 1, 19-24(1977). (In Russian).

Propagation stability of a spherical flame in a propane-air mixture in a small-volume chamber was studied by velocity schlieren kinematographic recordings ranging from a rich concentration with an excess air coefficient α of 0.47 (8.5 percent C_3H_8 in air) to a lean concentration with an α of 1.34 (3 percent C_3H_8 in air) and at initial pressures of from 1 to 5 atm. Pressure was simultaneously recorded.

32862 Flame spectra of CH_4, CH_3F, CH_2F_2, and CD_4 with fluorine at low pressure. Fedotov, N.G.; Sarkisov, O.M.; Vedeneev, V.I. (Inst. of Chemical Physics, Moscow). *Fiz. Goreniya Vzryva;* **13**: No. 1, 33-38(1977). (In Russian).

Flame spectral studies are made of the fluorination of methane and its derivatives at a pressure of approximately 1 torr. The flame spectra for CH_4 and CH_3F with fluorine were found to coincide and were brought about by the formation of the electron-excited radical CHF. The CHF bands are absent in the flame spectrum of CH_2F_2 with fluorine. The flame spectrum of $F_2 + CD_4$ was also produced and analyzed. That spectrum could also be correlated with the DCF radical. The vibration frequency for the DCF radical was also determined.

32863 Pipeline transmission of coal-derived gases. Chuang, K.C.; Nichols, D.G. (West Virginia Univ., Morgantown, WV). pp 95-99 of

Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

For synthetic natural gas, industrial fuel gas, and hydrogen, eignineering cost models have been developed which represent both the capital and operating costs of pipeline transport. These models have been used for the digital computer simulation, optimization, and evaluation of pipeline systems. The results are presented and compared.

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 32578, 32579, 33516

32864 (DOE/EIS—0002) **Allocation of petroleum feedstock: Baltimore Gas and Electric Company, Sollers Point SNG Plant, Sollers Point, Baltimore County, Maryland. Final environmental impact statement.** (Department of Energy, Washington, D.C. (USA)). Apr 1978. 340p. Dep. NTIS, PC A15/MF A01.

An allocation of naphtha feedstock up to 2,186,000 barrels per year to Baltimore Gas and Electric Company (BG and E) to operate its synthetic natural gas (SNG) facility is being considered. The allocation would enable BG and E to produce 10,800,000 mcf of SNG during a 180 day period. Operation of the plant at design capacity is expected to result in annual pollution emissions as follows: 626.4 tons of sulfur oxides, 168.5 tons of nitrogen oxides and 21.6 tons of particulate matter. Incremental emissions due to plant operations relative to existing emissions in Baltimore County are less than 1%. All Federal and State air quality standards should be met. Treated effluent is to be discharged into the Patapasco River where the environmental impacts are not expected to be significant. The SNG facility has been designed to be in compliance with all applicable Federal, State and local effluent standards. Water consumption requirements of 335,000 gallons per day are not expected to significantly tax the area's water resources. Sound generated by the SNG facility will be inaudible or imperceptible. All other operational impacts on land use, population, visual quality, roadways, community facilities and services and ecological systems were judged to be minimal. Environmental impacts resulting from various alternatives ranging from full allocation through denial of an allocation are discussed.

32865 (FE—2490-3) **Fluid bed process studies on selective conversion of methanol to high octane gasoline. Quarterly report No. 1, October—December 1976.** Lee, W. (Mobil Research and Development Corp., Paulsboro, N.J. (USA)). Jan 1977. Contract EX-76-C-01-2490. 39p. Dep. NTIS, PC A03/MF A01.

The fluid bed flow studies in the non-reacting pilot plant have demonstrated the feasibility of maintaining a constant fluidized bed with external recirculation of entrained catalyst. Basic fluid bed data such as bed density, voidage, and entrainment rate have been collected for gas superficial velocities of 0.5-2.0 ft/sec. These velocities have been estimated for commercially sized fluid bed reactors. For the ranges studied here, the gas superficial velocity has been found to have strong effects on bed density, entrainment rate, and recirculation rate. Significant progress has been made in the design and engineering of the fluid bed methanol to gasoline pilot plant. Achievements include the completion of pilot plant flow scheme, finalization of the reactor-regenerator design, process calculation for target operating conditions, methanol supply and storage logistics, selection and preparation of construction site, and ordering of equipment which require long delivery time.

32866 **Process for production of purified and humidified fuel gas.** McGann, R. (to Texaco Inc.). US Patent 4,075,831. 28 Feb 1978. Filed date 27 Oct 1976. 10p.

This is a continuous process for producing a stream of purified and humidified fuel gas which may be burned in a gas turbine to produce mechanical work and electrical energy without contaminating the environment. In the process, a feed stream of raw fuel gas is preferably produced by the partial oxidation of a hydrocarbonaceous fuel with a free-oxygen containing gas, optionally in the presence of a temperature moderator. The raw fuel gas stream is then preferably saturated with water during cooling and cleaning operations. It is then passed in indirect countercurrent heat exchange with a stream of purified fuel gas containing substantially no water. The later stream was produced by cooling and purifying said raw fuel gas stream. At least a portion of the water which is condensed out of the raw fuel gas during said cooling operation is separated and revaporized into said purified fuel gas stream. The resulting stream of purified and humidified fuel gas may be used as fuel in a gas turbine. Maximum low level heat recovery is achieved in the process along with providing the purified fuel gas stream with additional mass for expansion in the turbine.

32867 **Process for producing synthetic natural gas and high octane motor fuel components.** Pfefferie, W.C.; Hettinger, W.P. Jr. (to Engelhard Minerals and Chemicals Corp.). US Patent 4,073,716. 14 Feb 1978. Filed date 7 Nov 1975. 12p.

Synthetic natural gas and high octane motor fuel blending stock is produced by catalytically reforming naphtha at low severity to maximize production of aromatics and minimize hydrocracking, and then converting the remaining paraffins to methane in a methanation zone. The effluent from the methanation zone is separated into synthetic natural gas and motor fuel blending stock.

32868 **Process for producing methane from carbon monoxide and steam.** Johnson, M.M.; Nowack, G.P. (to Phillips Petroleum Co.). US Patent 4,071,331. 31 Jan 1978. Filed date 19 Nov 1976. 8p.

A catalyst consisting essentially of nickel, a promoter selected from the group consisting of barium and uranium and a calcium phosphate support having a Ca:P atomic ratio in the range of 1.4:1 to 2.3:1, is formed by impregnating a calcium phosphate gel with suitable compounds of nickel and either barium or uranium. The resulting catalysts are useful for reacting carbon monoxide and steam and in steam reforming processes for producing methane.

32869 **Method for production of acetylene by laser irradiation.** Manuccia, T.J. (to Secretary of the Navy). US Patent 4,070,412. 24 Jan 1978. Filed date 8 Sep 1976. 4p.

Acetylene is produced by pyrolytic cracking of hydrocarbons following laser volumetric heating by: doping the feed stock with an absorbing gas such as ethylene to absorb laser radiation in a controlled manner; applying laser radiation in the form of a sheet with a thickness from about 5 to about 20 mm perpendicular to the flow direction of the feed stock; maintaining a reaction temperature around 1800° to 2000°K by adjusting the energy output of the laser; and maintaining the temperature of the reaction chamber walls below 1000°K.

32870 **Stoichiometric calculations for the Fischer-Tropsch synthesis.** Roelen, O. *Erdoel Kohle, Erdgas, Petrochem. Brennst.-Chem.;* **30**: No. 10, 456-461(Oct 1977). (In German).

The complicated stoichiometry of the Fischer-Tropsch-Synthesis with its large unknown number of reaction products has not received a uniform treatment. It was, therefore, a problem to evaluate the results. Starting with a basic equation, a series of mathematical expressions are derived for the calculation of characteristic values and yields. Furthermore, methods of error estimation and advance calculation of C:H-consumption ratio are described.

32871 **Future processes for the production of SNG.** Stroud, H.J.F. (Br Gas Corp, Midlands Res Stn, Engl). *Gas Eng. Manage.;* **17**: No. 10, 355-366(Oct 1977).

This article presents the factors which need to be considered in the design of an SNG (Substitute Natural Gas) process and then describes a range of such processes. The advantages of making SNG to support a "Methane Economy" as opposed to changing to a "Hydrogen Economy" are clearly evident from this presentation. The processes described include those for gasifying either oil or coal, and special emphasis is given to the possible future role of nuclear energy in reducing the amount of fossil fuels required to make base-load SNG. 11 refs.

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 32890, 32891, 33849

32872 **Sugar as a substitute for natural oil.** *Chem.-Ing.-Tech.;* **49**: No. 9, A462(Sep 1977). (In German).

Sugar may either be used as a fuel after fermentation to ethanol or after gasification to synthetic natural gas, or it may be directly used as a raw material for the chemical industry. It is technically possible to produce methane, methanol, and ethanol/ethylene on a saccharose basis. In some countries, such processes are already being implemented on a technical scale. When using saccharose as a chemical raw material, a number of by-products are obtained which make it much harder to separate and clean individual compounds and which also use up a considerable amount of the sugar. In spite of this in Japan, France, Brazil, and other countries, tensides (1,000 t/a), softeners and, by purposeful fermentation processes, xanthane (a water-thickening agent) are produced from saccharose, and plants for alginate production are being planned. The main problems still remain in the complicated and expensive processing procedure for the reaction products.

ALCOHOL FUELS

REFER ALSO TO CITATION(S) 33328 33392, 33396

PREPARATION

CHEMICAL SYNTHESIS

REFER ALSO TO CITATION(S) 33397, 33516

PREPARATION FROM WASTES OR BIOMASS

REFER ALSO TO CITATION(S) 32872, 32890, 33849, 33850

32873 (PB—272646) **Environmental assessment of waste-to-energy processes: source assessment document.** Ananth, K.P.; Shannon, L.J.; Schrag, M.P. (Midwest Research Inst., Kansas City, Mo. (USA)). Aug 1977. Contract EPA-68-02-2166. 81p. NTIS PC A05/MF A01.

The program has the overall objective of identifying environmental impacts which might result from waste-to-energy conversion processes. These processes are categorized, on a generic basis, as: (a) waterwall incinerators; (b) combined firing systems; (c) thermochemical (pyrolysis) processes; (d) hog-fuel boilers; (e) biochemical systems; and (f) advanced combustion systems such as the CPU 400. This report discusses constituents in solid waste primarily with the idea of illustrating the diverse nature of the feedstock used in such systems. Also presented is an environmental impact analysis based on the contribution of each waste-to-energy conversion system to criteria and other major pollutants. Where emission data were lacking, engineering judgment was used to identify probable levels. A simplified methodology for a preliminary environmental assessment is illustrated. An overview of each of the waste-to-energy conversion systems including their pollution potential and applicable control technology is also contained in this document. The status of such systems as well as their locations, capacities and processing steps involved is identified, to the extent possible.

PREPARATION

32874 **Experience in the development and operation of mass exchange equipment for monoethanolamine removal of CO_2 from gas in the production of ammonia.** Gridin, I.D.; Polyakova, G.I.; Karlamov, V.V.; Chelabova, S.P.; Sokolov, A.M.; Sergeev, Yu.S. *Sov. Chem. Ind. (Engl. Transl.);* **9**: No. 11, 902-903(Nov 1977).

Translated from Khim. Prom-st. (Moscow); No. 11, 865-866(1977).

The possibility is examined of reducing the operating and capital costs for removing CO_2 from converter gas with an aqueous MEA solution by using rational mass exchange equipment. A comparison of the calculated operating characteristics of the absorber and regenerator shows that the equipment used in the purification system which has been adopted ensures minimum heat costs.

SOLID WASTE FUELS

32875 **Potential of forest fuels for producing electrical energy.** Burgess, R.L. (Oak Ridge National Lab., TN). *J. For.;* **76**: No. 3, 154-157(Mar 1978).

Annual aboveground wood increment in the world's forests is approximately 12.9 billion metric tons. At 50 percent accessibility, about 6.5 billion tons are available for all wood uses. On the assumptions of 3.5 x 10^6 kcal/ton of air-dried wood, a thermal-electric conversion of about 35 percent, and a power station running at 60 percent operating efficiency, then one megawatt per year requires about 6,200 tons of wood annually. Therefore, if all wood was used for electrical generation, maximum production from the world's forests would amount to 1.0 x 10^6 mWe (megawatts electric), without dipping into capital. This is roughly twice the equivalent of the present U.S. generating capacity, and half that projected for the year 2000.

HYDRO ENERGY

REFER ALSO TO CITATION(S) 33210

PLANT DESIGN AND OPERATION

32876 **Prime mover for obtaining energy from flow of a river.** Mouton, W.J. Jr.; Thompson, D.F. German(FRG) Patent 2,635,529/A/. 28 Apr 1977. 45p. (In German).

The invention concerns a water power machine, which is to convert the energy of flow of a river into mechanical work. There are many situations where the damming of flowing water is impossible because of the ground configuration, or where the flowing water has to remain free for navigation purposes. Previous attempts to use the kinetic energy of the river water instead of the potential energy in such cases have failed. The design of the water power machine described here is in the form of a catamaran with two pontoons. Below each pontoon there is a main nozzle of 20 meters inlet diameter, 12.2 meters throat diameter, 14.6 meters outlet diameter and 18.3 meters total length. There is a rotor with blades, sealing ring and central shaft coaxial to the throat in the internal water path of the main nozzle. Upstream from the inlet of the main nozzle water path there is a protective shield in the shape of a cone made of cables, whose point is fixed to an anchor situated upstream. Downstream there is an auxiliary nozzle, coaxial with the main nozzle, and projecting over its outlet, with an inlet diameter of 27.5 meters, a throat diameter of 20.8 meters, an outlet diameter of 23.2 meters and an overall length of 21.4 meters. The flow flowing externally around the main nozzle is accelerated on entry into the auxiliary nozzle, and can therefore not enter the outlet opening of the main nozzle, but permits onobstructed exit of the slowed flow in the main nozzle due to extraction of energyThere are electrical generators and a supporting mast for the transmission line of the deck of the catamaran. The river must have a depth of water of at least 30 meters, like the Mississippi at New Orleans, for a craft of the above dimensions.

32877 **Extension of the Stubach Power Plant Group of the Austrian Federal Railways.** Wohlgemuth, J. *Elektr. Bahnen;* **48**: No. 3, 66-72(1977). (In German).

In the center of Austrian Federal Railways electric power supply network the Stubach hydroelectric power stations are situated which have been erected since 1920. The rapid increase of traffic during the past 50 years forced the operators to extend the group of power stations in such way that any available quantity of water can be utilized for the generation of electricity. A description is given in the present article of the extension, the water and energy supply. Course of construction, precautions of maintenance and operational control are mentioned.

SOLAR ENERGY

32878 (DOE/ET—0036) **Guide to solar energy programs.** (Department of Energy, Washington, D.C. (USA). Div. of Solar Technology). Mar 1978. 72p. Dep. NTIS, PC A04/MF A01.

The mission and objectives of the U.S. Department of Energy (DOE) are outlined. An overview of DOE's solar energy programs is given, including (1) the solar thermal power systems program, (2) the photovoltaic systems program, (3) the fuels from biomass program, (4) the ocean thermal systems program, and (5) the wind energy systems program. Also, the environmental and resource assessment program and the satellite power system program are described. Solar energy programs now functioning under the Division of Conservation and Solar Applications are described, including the solar technology transfer program and the thermal applications program. Methods of procurement and guides for proposal preparation and sources of solar energy information and activities supporting the solar energy program are discussed. (WHK)

32879 **Second status seminar investigates the utilization of solar energy.** Schreitmueller, K.R. *Brennst.-Waerme-Kraft;* **29**: No. 11, 452-453(Nov 1977). (In German).

The second status seminar 'Solar energy' of the Federal Ministry for Research and Technology was held on September 20th and 21st 1977 in Bonn. About 150 representatives from industry and research took part. In almost 40 lectures it was reported on research projects concerning solar energy utilization promoted by the Ministry.

32880 **Proceedings of the fourteenth space congress on space technology for better living.** Canaveral, FL; Canaveral Council of Technical Societies (1977). 266p. (CONF-770468—). .

From 14. space congress proceedings; Cocoa Beach, FL, USA (27 Apr 1977).

Thirty papers are included. Separate abstracts were prepared for five on solar applications. (MHR)

32881 **Solar energy: its conversion and utilization.** Farber, E.A. (Univ. of Florida, Gainesville). pp 4.1-4.4 of Proceedings of the fourteenth space congress on space technology for better living. Canaveral, FL; Canaveral Council of Technical Societies (1977).

From 14. space congress proceedings; Cocoa Beach, FL, USA (27 Apr 1977).

See CONF-770468—.

The needs, status and potential of solar energy are presented and the various applications are put into proper perspective. The fact is emphasized that all energy sources are needed to solve the energy problems and the ones should be used which can do the job best. It is

also pointed out that one must learn to live off energy income instead of savings and with solar energy, the only large inexhaustible income, the choice is limited.

32882 Energy initiatives: in Florida and elsewhere. Yarosh, M.M. (Florida Solar Energy Center, Cape Canaveral). pp 4.24-4.28 of Proceedings of the fourteenth space congress on space technology for better living. Canaveral, FL; Canaveral Council of Technical Societies (1977).

From 14. space congress proceedings; Cocoa Beach, FL, USA (27 Apr 1977).

See CONF-770468—.

Recommendations and legislation initiated by the Florida Energy Committee, which led to the creation of the Florida Solar Energy Center, are reviewed. The programs and operation of this Center are briefly reviewed. Some problems and promises for the future of solar energy are also discussed.

RESOURCES AND AVAILABILITY

32883 (AD—480327) **The design and construction of thin film radiation thermopiles. Technical report 1 Nov 64—31 Jul 65.** Frazine, D.F. (Arnold Engineering Development Center, Arnold Air Force Station, Tenn. (USA)). Apr 1966. Contract AF 40(600)-1200. 21p. (AEDC-TR—66-38). NTIS PC A02/MF A01.

Thin film radiation thermopiles promise substantial improvement in detector performance and construction cost over conventional solid-wire thermopiles when used in space simulation chambers for measuring simulated solar total irradiance. Three types of substrates were used during the investigation of thin film construction techniques: (1) aluminum foil suspended over a channel cut in the heat sink, (2) thin Mylar suspended over a channel cut in the heat sink, and (3) the heat sink containing a channel which is filled with an insulating resin. These substrates provide thermal resistance between active and reference junctions. Sixteen junction thermopiles of bismuth and antimony were vacuum evaporated onto the substrates, and the completed detectors were tested for sensitivity, response time, and resistance to damage caused by temperature cycling over the range from 80 to 440 K. (Author)

ECONOMICS

REFER ALSO TO CITATION(S) 32918

ENVIRONMENTAL, LEGAL, AND INSTITUTIONAL ASPECTS

REFER ALSO TO CITATION(S) 32914, 33668, 33761

SOLAR ENERGY CONVERSION

32884 Direct transformation of solar energy into three-phase current for technical uses. von Hacht, G. (Ingenieurbuero Opto-Sensor-Technik, Frankfurt am Main (Germany, F.R.)). *Waerme;* **83**: No. 4, 53-56(Aug 1977). (In German).

The author proposes a method which may increase the 15% efficiency of present solar plants. In principle, the device consists of an optical waveguide tube containing a chain of solar elements. The tube serves as conductive wire for the primary coil of an a.c. or three-phase current transformer. The 50 Hz cycle of the a.c. or three-phase current is generated by rotor or cylindrical diaphragms and/or electronic pilot/thyristor control. The solar energy is focussed axially and/or vertically to the axis of the optical waveguide tube. The light going through the optical waveguide tube makes it possible for solar elements to be equipped with light-sensitive layers on both sides instead of just on one side, as until now. This means a higher efficiency than for conventional solar elements exposed to light only on one side. In addition, the optical waveguide tube is designed in its length as Fabry-Perot resonator. This way, it may also be used as a gas laser. The light generated in this gas laser would multiply the luminous intensity which again acts on the two light-sensitive sides of the solar elements, thus again increasing their efficiency.

PHOTOVOLTAIC CONVERSION

REFER ALSO TO CITATION(S) 32893, 32894, 32895

32885 (DOE/JPL/954442—1) **Semiconductor grade, solar silicon purification project. Technical quarterly report No. 8, 1 October 1977—31 December 1977. Motorola report No. 2257/8.** Ingle, W.M.; Chaney, R.; Thompson, S.; Rosler, D.; Jackson, J. (Motorola, Inc., Phoenix, Ariz. (USA). Semiconductor Group). 21 Dec 1977. Contract NAS7-100-954442. 40p. Dep. NTIS, PC A03/MF A01.

The technical progress reported in the current quarterly report can be divided into five task areas. They are as follows: (1) Spectroscopic Analysis and Characterization of the (SiF_2)/sub x/ Polymer and Si/sub x/F/sub y/ Homologues. Preliminary analysis utilizing N.M.R., T.G.A., D.S.C. and Mass Spec. are consistent with both the (SiF_2)/sub x/ polymer and Si/sub x/F/sub y/ homologues being nearly identical in chemical composition (mainly SiF_2 group in long chain polymers or cyclic homologues) and thermal stability. (2) Experiments Involving Si/sub x/F/sub y/ Homologue Conversion Chemical Vapor Deposition of Silicon. Results from these experiments demonstrate that a bed of heated (850°C) silicon chunks is an effective way to convert the homologues into silicon in high yield. (3) Demonstration Runs on the Near-Continuous Apparatus. The near-continuous apparatus has been operated at rates greater than or equal to 25 gm/hr in two multihour series of runs for silicon production and parameter optimization. In the most recent series, the apparatus was operated for 8 hours in a near-continuous fashion during which 155 grams of silicon was purified and a weighed silicon mass balance revealed approximately 100 percent of the silicon accounted for. (4) Economic Analysis. An economic analysis incorporating a Si/sub x/F/sub y/ recycle step in the purification process reduces the cost of purifying silicon via the present process (assuming $10MM fixed capital investment) to $7.68/Kg Si. (5) Silicon Sample Analysis. Representative silicon samples have been submitted for SSMS elemental analyses. As they become available they will be reported.

32886 (DOE/JPL/954607—2) **Development and testing of shingle-type solar cell modules. Quarterly report No. 2.** Shepard, N.F. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 5 Jan 1978. Contract NAS-7-100-954607. 49p. Dep. NTIS, PC A03/MF A01.

The details of a shingle module design which produces in excess of 97 watts/m² of module area at 1 kW/m² insolation and at 60°C are reported. This selected design employs a tempered glass coverplate to provide the primary solar cell structural support. The use of the B.F. Goodrich FLEXSEAL roofing system as the outer skin of the shingle substrate provides a high confidence of achieving the 15 year service life goal. The fabrication and testing of a preproduction module of this design has demonstrated that this selected approach will meet the environmental testing requirements imposed by the contract. Attempts to fabricate a preproduction module of an alternative design, which embeds the solar cell assembly within a methyl methacrylate casting, proved unsuccessful.

32887 (ERDA/JPL/954527—77/4) **Investigation of test methods, material properties, and processes for solar cell encapsulants. Sixth quarterly progress report, August 12, 1977—November 12, 1977.** (Springborn Labs., Inc., Enfield, Conn. (USA)). Nov 1977. Contract NAS-7-100-95457. 49p. Dep. NTIS, PC A03/MF A01.

The goal of this program is to identify, evaluate, and recommend encapsulant materials and processes for the production of cost-effective, long-life solar cell modules. During this quarter, flat-plate solar array systems were considered and six basic construction elements were identified: outer coatings, superstrates, pottants, substrates, undercoats, and adhesives. Materials surveys were then initiated to discover either generic classes and/or specific products to function as each construction element. Cost data included in the surveys permit ready evaluation of each material in terms of the LSSA 1982 and 1985 target costs (materials allocation for 1985 is $0.23 per square foot). Silicones, fluorocarbons, glass, and acrylic polymers have the highest inherent weatherability of materials studied to date. Only acrylics, however, combine low cost, environmental resistance, and potential processability. This class will receive particular emphasis. Low-cost coatings to screen out deleterious ultraviolet light were also investigated, with considerable success. One-mil coatings of acrylic resin containing UV absorbers were prepared in the laboratory and found to have zero percent ultraviolet transmittance in several cases. These coatings may permit the use of low-cost, uv-unstable materials as encapsulants. The plasma-spray process of applying conformal coatings received further attention this quarter but still proved to be unsuccessful in laboratory trials on miniature modules.

32888 New ways to make solar cells trim costs of future sun power for your home. Edelson, E. *Pop. Sci.;* 74-78(May 1976).

A general explanation of the workings of silicon solar cells is given. The advantages of using polycrystalline silicon are reviewed. (MHR)

32889 Power supply systems with solar generators. *Int. Elektron. Rundsch.;* **30**: No. 9, 205-206(1976). (In German).

The principle of solar generators is described, and the many possible applications of these devices, wherever energy is needed, are pointed out. As many telecommunication equipments are nonsystem-connected and independent communication systems are needed

especially in the Third World, this contribution is of particular interest to telecommunication engineers.

BIOMASS PRODUCTION AND CONVERSION

REFER ALSO TO CITATION(S) 32875

32890 (LBL—7270) **Fermentation and hydrocarbons.** Calvin, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Jan 1978. Contract W-7405-ENG-48. 62p. (CONF-780128—1). Dep. NTIS, PC A04/MF A01.

From 2. Latin-American Botanical Congress; Brasilia, Brazil (22 Jan 1978).

Photosynthesis is examined as a possible annually renewable resource for material and energy. The production of fermentation alcohol from sugar cane as a major component of materials for chemical feedstocks is examined as well as the direct photosynthetic production of hydrocarbon from known plant sources. Experiments are underway to analyze the hydrocarbons from Euphorbias, Asclepias and other hydrocarbon-containing plants with a view toward determining their various chemical components. In addition, experimental plantings of plants of this type have begun to obtain data on which species would be the most successful. Work is also underway on the development of chemical process techniques for the extraction of plant materials after harvesting. In addition, efforts are underway to construct synthetic systems on the basis of the knowledge of the natural photosynthetic processes. These systems could be used to produce fuel, fertilizer, and power. As a result of studies of the natural quantum conversion process in green plants, several photoelectron transfer processes, some of which have already been demonstrated in synthetic systems, can be envisaged. Methods of constructing systems of this type and the principles of their use are described.

32891 (TID—27904/1) **Evaluation of the use of agricultural residues as an energy feedstock: a ten-site survey. Volume I. Summary and general information.** Alich, J.A. Jr.; Schooley, F.A.; Ernest, R.K.; Hamilton, R.; Louks, B.M.; Miller, K.A.; Veblen, T.C.; Witwer, J.G. (Stanford Linear Accelerator Center, Calif. (USA)). Jul 1977. Contract EY-76-C-03-0115. 96p. Dep. NTIS, PC A05/MF A01.

Results of a study of the feasibility of converting agricultural residues to produce energy are presented. On-site surveys were made of ten study areas selected for analysis on the basis of a previous SRI county-by-county inventory of the quantity and availability of residues produced within the continental United States. Two important factors in determining the feasibility of residue conversion to energy are price and availability of the residues. Eight of the ten study areas have significant quantities of relatively low-cost residues. Three currently available proven technologies, process steam production, electric power generation, and anaerobic digestion of residues to produce methane gas, are the most economically feasible conversion possibilities. Residue conversion by these technologies is frequently cost-competitive with energy production at new facilities fueled with oil, propane, coal, or natural gas.

PHOTOCHEMICAL AND THERMOCHEMICAL CONVERSION

32892 **Rotating platinum-semiconductor ring-disc electrode for analysis of photoelectrochemical processes.** Memming, R. (Philips Forschungslaboratorium G.m.b.H., Hamburg (Germany, F.R.)). *Ber. Bunsenges. Phys. Chem.;* **81**: No. 8, 732-735(Aug 1977).

For analysis of photoinduced charge transfer processes at semiconductor electrodes a special ring-disc electrode has been developed and tested. This electrode, consisting of a semiconductor disc and platinum ring, makes it possible to determine in situ electron transfer between redox systems and semiconductor electrode during simultaneous anodic dissolution. Data obtained with a CdS-disc electrode are discussed.

PHOTOVOLTAIC POWER PLANTS

REFER ALSO TO CITATION(S) 32899, 32900, 32982, 33211

32893 (ALO/2748—12(Vol.5)) **Photovoltaic systems concept study. Final report.** (Spectrolab, Inc., Sylmar, Calif. (USA)). Apr 1977. Contract EY-76-C-04-2748. 212p. Dep. NTIS, PC A10/MF A01.

The following appendices are included: economic theory, electric utilities, and peak load pricing; evaluating the total cost of an on-site solar energy system; derivation of PEPS cost model; PEPS economic analysis model; scenarios; the effect of governmental "subsidies" on the nuclear power industry; discussion of energy industry subsidies; extension of the Hottel-Whillier-Bliss model to the analysis of combined photovoltaic/thermal flat plate collectors; analysis of solar-augmented rock-bed/heat pump system; TRNSYS results for Washington, D.C. residence with air collectors, rock-bed storage, and parallel Airesearch heat pump; tabulation of electrical loads for Phoenix, Riverside, and Cleveland using a simplified hourly method; evaporative air coolers; cooling efficiency and electrical consumption; and Hoover Dam operation. (MHR)

32894 (ALO/3686—14(Vol.1)) **Conceptual design and systems analysis of photovoltaic systems. Volume I. Study summary. Final report.** Kirpich, A. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 19 Mar 1977. Contract EY-76-C-04-3686. 42p. Dep. NTIS, PC A03/MF A01.

This investigation of terrestrial PV systems considered the technical and economic feasibility for systems in three size categories: a small system of about 12 kW peak output for on-site residential use; a large 1500 MW central power plant contributing to the bulk energy of a utility system power grid; and an intermediate size system of about 250 kW for use on public or commercial buildings. In each category, conceptual designs were developed, performance was analyzed for a range of climatic regions, economic analyses were performed, and assessments were made of pertinent institutional issues. The report consists of three volumes. This volume contains a Study Summary of the major study results. Volume II contains the detailed results pertaining to on-site residential photovoltaic systems, central power plant photovoltaic systems, and intermediate size systems applied to commercial and public buildings. Volume III contains supporting appendix material. (WHK)

32895 (ALO/3686—14(Vol.2)) **Conceptual design and systems analysis of photovoltaic systems. Volume II. Study results. Final report.** Kirpich, A. (General Electric Co., Philadelphia, Pa. (USA). Space Div.). 19 Mar 1977. Contract EY-76-C-14-3686. 332p. Dep. NTIS, PC A15/MF A01.

This investigation of terrestrial PV systems considered the technical and economic feasibility for systems in three size categories: a small system of about 12 kW peak output for on-site residential use; a large 1500 MW central power plant contributing to the bulk energy of a utility system power grid; and an intermediate size system of about 250 kW for use on public or commercial buildings. In each category, conceptual designs were developed, performance was analyzed for a range of climatic regions, economic analyses were performed, and assessments were made of pertinent institutional issues. The report consists of three volumes. Volume I contains a Study Summary of the major study results. This volume contains the detailed results pertaining to on-site residential photovoltaic systems, central power plant photovoltaic systems, and intermediate size systems applied to commercial and public buildings. Volume III contains supporting appendix material. (WHK)

32896 (DOE/NASA/1022—78/29) **Photovoltaic water pumping applications: assessment of the near-term market.** Rosenblum, L.; Bifano, W.J.; Scudder, L.R.; Poley, W.A.; Cusick, J.P. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Mar 1978. Contract EX-76-A-29-1022. 25p. (NASA-TM—78847). Dep. NTIS, PC A02/MF A01.

A preliminary assessment of the near-term market for photovoltaic water pumping applications is presented. One of the objectives of the Department of Energy's (DOE) National Photovoltaic Program is to stimulate the demand for photovoltaic power systems so that appropriate markets will be developed in the near-term to support the increasing photovoltaic production capacity also being developed by DOE. Water pumping applications represent such a potential market for photovoltaics. The price of energy for photovoltaic systems is compared to that of utility line extensions and diesel generators. The potential "domestic" demand is defined in the government, commercial/institutional and public sectors. The foreign demand and sources of funding for water pumping systems in the developing countries are also discussed briefly. It is concluded that a near-term domestic market of at least 240 megawatts (peak) and a foreign market of about 6 gigawatts (peak) exists and that significant market penetrations should be possible beginning in the 1981-82 period.

SOLAR THERMAL POWER PLANTS

REFER ALSO TO CITATION(S) 32982

32897 (NTIS/PS—77/0897) **Solar electric power generation. Volume 1. 1964 — 1975 (citations from the NTIS data base). Report for 1964-75.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 167p. NTIS PC N01/MF N01.

Citations of Federally-funded research are presented pertaining to terrestrial electric power generation by both direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover equipment design, site surveys, economics, and feasibility studies. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. (This updated bibliography

contains 162 abstracts, none of which are new entries to the previous edition.)

32898 (NTIS/PS—77/0898) **Solar electric power generation. Volume 2. 1976-September 1977 (citations from the NTIS data base). Report for 1976-Sep 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 144p. NTIS PC N01/MF N01.

Citations of Federally-funded research are presented pertaining to terrestrial electric power generation by both direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover equipment design, site surveys, economics, and feasibility studies. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. (This updated bibliography contains 139 abstracts, 84 of which are new entries to the previous edition.)

32899 (NTIS/PS—77/0899) **Solar electric power generation. Volume 1. 1970-1975 (citations from the Engineering Index data base). Report for 1970-75.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 138p. NTIS PC N01/MF N01.

A worldwide literature survey cites power generation by direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover solar tower power plants, orbital solar energy technology, photovoltaic power generation, and solar augmentation of hydroelectric power systems. A few abstracts pertain to the future role that solar energy will play in production of electric power and general studies comparing the technical and economic feasibility of various methods of electric power generation. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. (This updated bibliography contains 131 abstracts, none of which are new entries to the previous edition.)

32900 (NTIS/PS—77/0900) **Solar electric power generation. Volume 2. 1976-September 1977 (citations from the Engineering Index data base). Report for 1976-Sep 77.** Hundemann, A.S. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 183p. NTIS PC N01/MF N01.

A worldwide literature survey cites power generation by direct conversion with solar cells and indirect conversion using solar heat. Topic areas cover solar tower power plants, orbital solar energy technology, photovoltaic power generation, and solar augmentation of hydroelectric power systems. A few abstracts pertain to the future role that solar energy will play in production of electric power and general studies comparing the technical and economic feasibility of various methods of electric power generation. Abstracts dealing with solar sea power generation and spacecraft power supplies are excluded. (This updated bibliography contains 176 abstracts, 112 of which are new entries to the previous edition.)

CENTRAL RECEIVER

32901 **Servo positioning power tower collectors for solar heat conversion to electricity.** Parker, R.S. (Honeywell, Inc., St. Petersburg, FL). pp 84-89 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

An overview of Honeywell's Power Tower concept for conversion of solar generated heat to electricity is presented. The Solar Collector Subsystem control problem is defined. Operating modes including normal tracking, offset pointing, periodic calibration, stowage, and initialization are explained. Mathematics of sun vector computation and atmospheric refraction compensation are discussed. The process of attitude command generation and communication to the individual heliostats is outlined. Features of the control concept which contribute to cost effectiveness are highlighted throughout.

OCEAN THERMAL GRADIENT POWER PLANTS

REFER ALSO TO CITATION(S) 33761

32902 (TID—27815/1) **Ocean thermal energy conversion: test facilities study. Volume I. Test article and facility support requirements. Final report.** (TRW Systems and Energy, Redondo Beach, Calif. (USA)). Sep 1976. Contract EY-76-C-03-1159. 246p. Dep. NTIS, PC A11/MF A01.

Requirements were developed for both landbased and seabased test facilities to test OTEC heat engine components. Various energy-intensive industrial processes applicable to OTEC were examined. The requirements of both the OTEC heat engine hardware to be tested in the proposed test facilities and the equipment which would be necessary to support such tests are discussed. (MHR)

SOLAR RADIATION UTILIZATION

SPACE HEATING AND COOLING

32903 (AD—045042) **Second interim technical report on USAFA solar test house. Report for May 76—Apr 77.** Eden, A.; Tinsley, J.T. (Frank J. Seiler Research Lab., United States Air Force Academy, Colo. (USA)). Sep 1977. 165p. (FJSRL-TR—77-0016). NTIS PC A08/MF A01.

This report describes the continuing performance of the first retrofit-constructed, solar-heated facility in the USAF, the Solar Test House at the USAFA. The attempts at improving the performance of the system have centered on the following: additional heat exchangers; bleed air line and valves; ground array angle changes; reduced volume of storage tank; control temperature reductions; flow rate reductions and new data gathering system. The Solar Test House was modified to conserve thermal energy by using urea foam insulation in the ceilings, vestibules on the doors, and linear diffusers for the duct outlets. Thermography studies have been started to explore the flow patterns through the solar arrays and correlate pictures with multiplexed sensor readings. Daily, monthly, and yearly data analysis is reported to show the effects of the various system and operational changes and the improved performance. (Author)

32904 (AD—045082) **An attitudinal study of the home market for solar devices. Technical report Mar—Sep 77.** Campbell, V.N.; Brown, R.V.; Rhees, T.R.; Repici, D.J. (Decisions and Designs, Inc., McLean, Va. (USA)). Sep 1977. Contract N00014-75-C-0426. 71p. NTIS PC A04/MF A01.

This study estimates that 1.1 million American residences would have home and hot water heated with solar energy by 1985 if the total cost averaged $20 a month more than the cost of heating with fossil fuels, and initial costs were no barrier. An additional 7.2 million homes would have hot water alone heated with solar energy by 1985 if the total cost was $5 a month more. These are fairly favorable cost assumptions under current conditions. Almost half (44%) of potential homeowners surveyed would prefer to have their living spaces and hot water heated with solar energy if the total cost averaged $20 per month more than conventional heating and initial costs were no barrier. Although interest runs high, for various economic and technical reasons only about 1 in 75 American families may have both their home and water heated with solar energy by 1985. Any development that makes solar energy cost-competitive with fossil fuels for home heating will increase the level of market penetration. Another key to how quickly Americans will have solar homes is how fast builders and developers use solar energy in new homes and can assure good performance.

32905 (CONF-770367—, pp 1-7) **ERDA-USDA/ARS projects on solar heating and cooling of greenhouses and rural residences.** Bond, T.E. (ARS Rural Housing Research Unit, Clemson, SC). Nov 1977.

From Conference on solar energy for greenhouses and greenhouse-residential combinations; Cleveland, OH, USA (20 Mar 1977).

In Proceedings of a conference on solar energy for heating greehouses and greenhouse-residential combinations.

The location, the project manager, and the objectives of each of the eleven research programs are listed. (MHR)

32906 (COO/4593—1) **Unitary solar heating/cooling system package development. Progress report, June 1, 1977—January 31, 1978.** Merrick, R.H. (Arkla Industries, Inc., Evansville, Ind. (USA)). 1978. Contract EG-77-C-02-4593. 20p. Dep. NTIS, PC A02/MF A01.

During this period, a 3 ton residential system hardware package has been developed and is operating in an Arkla owned solar house in Evansville. The Arkla tower-cooled WF36 chiller has been substituted for the evaporatively cooled chiller under development in the package. The residential software and manufacturing programs are underway. Only preliminary thinking has been done on the commercial 25 ton program which will soon be getting major attention.

32907 (HCP/M4038—1) **Fundamentals of solar heating. Correspondence course.** (Sheet Metal and Air Conditioning Contractors National Association, Vienna, Va. (USA)). Jan 1978. Contract EG-77-C-01-4038. 176p. Dep. NTIS, PC A09/MF A01.

This correspondence course contains the following lessons: solar heating and cooling, solar radiation, solar collectors, heat storage, control devices and specialty items, sizing solar system components, operation of solar heating systems, domestic water heating, heating system installation, servicing, and legal responsibilities. (MHR)

32908 (HCP/M4038—02) **Study guide for fundamentals of solar heating. A correspondence course for the airconditioning industry.** (Sheet Metal and Air Conditioning Contractors National Associ-

ation, Vienna, Va. (USA)). Jan 1978. Contract EG-77-C-01-4038. 118p. Dep. NTIS, PC A06/MF A01.

The study guide to accompany the correspondence course (HCP/M4038--01) groups the eleven lessons into four study units. There are review tests and unit examinations, structured for assistance in reviewing the material and in integrating new information with that learned previously. (MHR)

32909 Power from the sun. McVeigh, J.C. (Brighton Polytechnic). *Architect (London);* **123**: No. 4, 56-59(Apr 1977).

Recent solar energy experiments in the United Kingdom are reviewed. An experimental domestic water and space heating system was installed in a standard terrace house; a 37 m^2 solar collector replaced part of the tiled roof of the house. About 70% of the hot water demand is met in summer months. One feature of the system is direct connection of aluminum roll bond panels to the main storage tank, with domestic hot water preheated by passing through heat exchangers in this tank. An old coach-house was converted into a four bedroom solar heated house. The whole south-western roof was replaced with standard corrugated aluminum panels painted with an acrylic matt black paint and single glazed with 4 mm horticultural glass. Water trickles down the channels from a horizontal perforated pipe just below the roof and is recirculated from the main storage tank. Estimations of 80% of the space and domestic water heating demand are met by the solar energy system. A solar heated house satisfying normal building society requirements employs a closed circuit system using a 30% glycol/water solution operating through conventional heat exchanger coils at the bottom of a standard 75 gallon combination cylinder for the domestic hot water. A 4000-liter spherical space-heating storage tank is buried outside the house. A solar space heating/domestic hot water system was installed in an exhibition hall with a total heated area of 200 m^2. A double glazed trickle-type collector contains a 70 m^2 main section inclined at 34° to horizontal and a 25 m^2 secondary section inclined at 70° to horizontal for better use of winter sunshine. The main heat storage tank of 100 m^3 capacity is divided into two temperature zones, with a fast response tank of 400 gallon capacity. The space heating consists of 10 mm diameter nylon pipe buried in the concrete floor of the building and connected directly to the heat storage tanks.

32910 Solar energy system retrofit. Hornak, J.P.; Knight, K. (Veterans Administration, Washington, DC). *Heat., Piping Air Cond.;* **50**: No. 1, 87-89(Jan 1978).

An existing research building at the VA's Wilmington, Del., hospital was chosen for the retrofit. The system consists of 5000 sq. ft. of double-glazed collectors with selectively coated copper absorber plates mounted at 40 deg.; a reflector, mounted at an angle of 30 deg; a 12,000 gal storage tank; a hot water coil to provide winter heating; an absorption chiller to provide summer cooling; and a comprehensive data recording system. The heating and cooling modes of the systems operation are illustrated. A drain-down system was selected to provide freeze protection. (MHR)

32911 Underground school gets its energy from the Sun. Davis, J.L. (James A. Federline, Inc., Gaithersburg, MD). *Heat., Piping Air Cond.;* **50**: No. 1, 93-96(Jan 1978).

The Terraset School at Reston, Va. is described. The three energy-saving features of the building are: the earth cover, the heat recovery system, and the solar heating and cooling system. The solar heating and cooling system is described in some detail. This system employs evacuated tube collectors to supply water at up to 240°F to two absorption chillers, piped in series with an electrically driven reciprocating chiller, to supply chilled water for cooling the building. The solar-heated water is also used directly for heating. (MHR)

32912 Solar greenhouse book. McCullagh, J.C. (ed.). Emmaus, PA; Rodale Press Inc. (1978). 339p. .

Details are given for constructing freestanding, attached, and pit greenhouses and solar coldframes. Historical and contemporary designs and regional examples are shown. Natural and artificial climate control, using the greenhouse as a solar collector to provide part of a home's heating requirement, heat loss and storage, glazing, and weather effects are discussed in detail from a design standpoint. Emphasis is on low-cost and non-technical application of solar energy. Information on light, energy, atmosphere, ventilation, irrigation, composting, soil nutrition, and insects and diseases are included. Chapters on solar greenhouse gardening tell how to grow various vegetables and other plants successfully. Special charts and appendices help the reader evaluate the cost-effectiveness of a solar greenhouse and locate a structure for maximum efficiency. (MHR)

32913 Solarthermische Heizungssysteme. Technische Aspekte und wirtschaftliche Grenzen. (Solar-thermal heating systems. Technical aspects and economic limits). Grallert, H. Muenchen, Germany, F.R.; Oldenbourg (1977). 216p. (In German).

After a general introduction of the principle of solar energy utilization and an explanation of boundary conditions, the author deals with the technical possibilities of solar energy conversion for space heating. A cost analysis shows the advantages and possible profitability of this sort of heating. For the time being, however, we must reckon with long amortisation times of 10-15 years. With regard to a relative cost comparison with other energy sources and to the potential of this energy conversion which is not being used yet, this system is sure to gain an important part of the energy supply in the future.

32914 Intermediate minimum property standards for solar heating and domestic hot water systems. Volume 5. Washington, DC; Dept. of Housing and Urban Development (1977). 294p. .

The following subjects are covered: general use, site design, building design, materials, and construction. The following information is included in appendices: calculation procedures for determining the thermal performance of solar domestic hot water and space heating systems, materials tables, illustrated definitions, definitions, referenced standards, and abbreviations. (MHR)

32915 San Francisco Bay area solar heating guide and directory. Bereny, J.A.; Carroll, J. San Mateo, CA; Solar Energy Information Services (1977). 60p. .

The following topics are discussed: the collection of solar energy, solar heating applications, economics of solar heating, and solar heating information resources. Included in the appendices are a product and service directory and an address and telephone directory. (MHR)

32916 University of Florida solar house. Ingley, H.A. (Univ. of Florida, Gainesville). pp 4.5-4.11 of Proceedings of the fourteenth space congress on space technology for better living. Canaveral, FL; Canaveral Council of Technical Societies (1977).

From 14. space congress proceedings; Cocoa Beach, FL, USA (27 Apr 1977).

See CONF-770468—.

Over the past 20 years, the University of Florida Solar Laboratory has contributed substantially to the knowledge now used in solar energy applications. One of the primary research objectives in recent years has been the utilization of solar energy at the residential level. Research in the areas of solar space heating and cooling, solar heated domestic water, solar cooking, and solar distillation of waste water are examples of the effort being made to meet this objective. Information is presented on each of these efforts. Details on system component design and evaluation are also included in this discussion.

32917 Solar properties of materials and testing of solar systems. Morrison, C.A. (Univ. of Florida, Gainesville). pp 4.12-4.17 of Proceedings of the fourteenth space congress on space technology for better living. Canaveral, FL; Canaveral Council of Technical Societies (1977).

From 14. space congress proceedings; Cocoa Beach, FL, USA (27 Apr 1977).

See CONF-770468—.

Because the solar industry is developing at an exponential rate, it is very important that responsible organizations and groups provide immediate standards for evaluating solar systems and the materials from which they are made. Some of the more important aspects of solar system testing are discussed briefly with emphasis placed on the experimental evaluation of the materials which make up these systems. Several test methods, which are being considered by many laboratories are presented.

32918 Financing the solar home. Barrett, D.; Epstein, P.; Haar, C.M. Lexington, MA; D. C. Heath and Co. (1977). 213p. .

The following chapters are included: the importance of the problem, how financing terms affect solar costs, overview of the residential mortgage market, attitudes toward innovation, attitudes toward energy and the solar alternative, factors in initial lending decisions, the availability of financing, attitudes of mortgage insurance and secondary market entities, considerations in the design of lender incentive programs, findings on program options, and recommendations for action. (MHR)

32919 Solar heating and cooling. Recent advances. Paul, J.K. Park Ridge, NJ; Noyes Data Corp. (1977). 492p.

The U.S. patent literature on solar heating and cooling since 1970 is covered in the following chapters: flat plate collectors, focusing collectors, upright collectors, other collectors, coatings, storage devices, heating and cooling systems, domestic hot water systems, and swimming pool applications. The material is indexed by subject, company, inventor, and patent number. (MHR)

32920 Seasonal stochastic simulation experiments on solar-air conditioning systems. Anand, D.K.; Allen, R.W.; Bazques, E.O. (Univ. of Maryland, College Park). pp 459-467 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Real weather data and stochastic weather models are used in simulating the performance of solar powered air-cooled and water-cooled air conditioning systems for an entire cooling season. The simulations included various parametric models for the absorption machinee and variation of collector area and mass flow rates. It is concluded that the stochastic data yield staisfactory results for various system configurations while permitting very inexpensive simulations.

32921 Solar houses in France. *Sonnenenergie-Tech.;* **2**: No. 6, 9-11(1976). (In German, English).

32922 Solar energy storage: 4 million heat units in the front yard. *Sanit. - Heizungstech.;* **41**: No. 1, 8-10(1976). (In German).

The system of a solar heating plant installed in a single-family house in Deizisau near Esslingen is described. Heat is emitted by a floor-radiator combination. On the roof, there is a collector area of about 16 m^2. Days without sunshine are bridged by two heat accumulators, the larger of which (70 m^3) is installed underground in the frontyard of the house.

WATER HEATING

REFER ALSO TO CITATION(S) 32906, 32907, 32908, 32909, 32914, 32915, 32916, 32919, 33262

32923 Rays of hope: a future of solar water heating . Courtney, R.G. *Buildings;* **229**: No. 6909, 137-141(14 Nov 1975).

The economic feasibility of using solar energy to provide hot water for domestic consumption or space heating purposes in the United Kingdom is analyzed. With regard to water heating, a solar system can provide about 5 GJ of useful heat each yr; however the initial cost is high when compared with the fuel savings achieved. For a system with a 4 m^2 collector area and an installed cost of about $600, the annual costs, ignoring maintenance costs and electricity consumption of the pump, amount to about $75/yr as compared to an annual saving of about $52/yr. Moreover, at least a 4% real increase in fuel costs/yr is required before the system becomes cost effective, even when on-peak electricity is replaced. A conventional radiator system for space heating cannot be used successfully with a solar heating system since such radiator systems use water at a temperature of about 75° C. However, heating coils in a warm-air system or for floor heating can be designed to work at 40°C, and heat pump could be used to upgrade low-temperature heat at 25°C from a solar collector. The initial costs of such a system at present would be high, however.

OTHER

REFER ALSO TO CITATION(S) 32916

SOLAR COLLECTORS AND CONCENTRATORS

REFER ALSO TO CITATION(S) 32893, 32919, 33399

32924 (SAND—77-2112C) **Thermal aging of electrodeposited black chrome.** Sowell, R.R.; Pettit, R.B. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 12p. (CONF-771230—1). Dep. NTIS, PC A02/MF A01.

From Thermal power systems workshop on selective absorber coatings; Golden, CO, USA (6 Dec 1977).

Portions of document are illegible.

Evaluation of selective absorbing coatings for Sandia's Solar Total Energy Test Facility included electrodeposited black nickel, multilayer interference coatings and Harshaw's electrodeposited black chrome (ChromOnyx). Black nickel coatings, although having acceptable optical properties, were unstable at the operating temperature of the facility (approximately 310°C) in air and at lower temperatures in the combined presence of heat and moisture. Multilayer interference coatings were expensive and difficult to apply to tubular geometries. There was also a question about long-term degradation of these coatings at 300°C that might result from diffusion between the evaporated layers. Electrodeposited black chrome was selected as the most suitable selective coating for our application. With proper substrate and plating control, acceptable optical properties (solar absorptance, α/sub s/, greater than or equal to 0.95 and emittance, epsilon, at 300°C less than or equal to 0.25) could be obtained with relative ease and at reasonable cost.

32925 Solar collector with altitude tracking. Barak, A.Z. (to Energy Research and Development Administration). US Patent 4,044,752. 30 Aug 1977. Filed date 1 Aug 1975. 8p.

PAT-APPL-601,112.

A device is provided for turning a solar collector about an east-west horizontal axis so that the collector is tilted toward the sun as the EWV altitude of the sun varies each day. It includes one or more heat responsive elements and a shading means aligned so that within a range of EWV altitudes of the sun during daylight hours the shading means shades the element or elements while during the rest of the daylight hours the element or elements are heated by the sun to assume heated, stable states. Mechanical linkage between the collector and the element is responsive to the states of the element or elements to tilt the collector in accordance with variations in the EWV altitude of the sun.

32926 System for the heating of buildings by means of a heat pump. Schimmelpfennig, K.; Bogdanski, F. (to Kabel- und Metallwerke Gutehoffnungshuette A.G., Hannover (Germany, F.R.)). German(FRG) Patent 2,557,895/A/. 30 Jun 1977. 12p. (In German).

The patent claim pertains to the design and arrangement of the evaporator of a heat pump. The evaporator consists of a large number of tubes, preferably copper tubes, running along the roof which are located in a container installed on the roof. This container is filled with a heat accumulator medium, e.g. water or black gravel. The tubes are connected at their ends, or bent meanderingly, and have a blackened surface. The invention aims at improving the efficiency of this heat exchanger by direct solar energy utilization and by utilizing the accumulator effect.

HEAT STORAGE

REFER ALSO TO CITATION(S) 32919, 32922

GEOTHERMAL ENERGY

32927 Potential of new non-nuclear and non-fossil energy sources. Lehner, G. (Institut fur Theorie der Elektrotechnik der Universitat Stuttgart, DE). *Tech. Mitt.;* **70**: No. 6/7, 349-354(1977). (In German).

The total energy of the Earth is composed of solar radiation (15.6 x 10^{17} kWh), geothermal energy (3 x 10^{14} kWh), and tidal energy (0.3 x 10^{14} kWh). The total energy demand in 1977 was 0.6 x 10^{14} kWh. Two tidal power plants are in operation, one in France and the other in the USSR. Normal heat flows of about 1.5 HFU (62.8 mW/m^2) are impractical for energy extraction, but areas with high heat flows and reservoirs of steam or hot water can be exploited for the production of electricity and the heating of buildings. The thermal energy stored in hot-dry-rock formations may contribute to the world energy supply, but the economics of their exploitation remains uncertain. Cooling the soil of W. Germany to 80°C to a depth of 7 km would yield about 4.9 x 10^{16} kWh. A possible environmental problem associated with hot-dry-rock systems could be earthquakes triggered by the cooling of the formations, with attendant volumetric changes. It is estimated that wind energy could be used to supply about 1/3 of the energy requirements of W. Germany. The most immediately applicable form of new energy would appear to be solar energy, which is easily collected and stored for domestic heating.

GEOLOGY, HYDROLOGY, AND GEOTHERMAL SYSTEMS

USA

32928 Geology of Salton Sea geothermal field. Towse, D. (Univ. of California, Livermore). *Am. Assoc. Pet. Geol. Bull.;* **60**: No. 4, 728(1976).

GEOTHERMAL EXPLORATION AND EXPLORATION TECHNOLOGY

32929 (LBL—7012) **Northern Nevada geothermal exploration strategy analysis.** Goldstein, N.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 58p. Dep. NTIS, PC A04/MF A01.

The results of exploration techniques applied to geothermal resource investigations in northern Nevada were evaluated and rated by seven investigators involved in the work. A quantitative rating scheme was used to obtain estimates of technique effectiveness. From survey cost information cost-effectiveness estimates for the various techniques were also obtained and compared. Effectiveness estimates were used to develop an exploration strategy for the area. However, because no deep confirmatory drilling has been done yet, the technique evaluations and exploration strategy must be consid-

ered as preliminary. The strategy was further studied by means of a decision tree analysis, merging the strategy with the timing of land acquisition and deep drilling to find the scenario that gives the highest cost-effectiveness values for drilling success, overall project success, and maximum expected returns on exploration investment. Based on assumed probabilities it is shown that land acquisition should be deferred until after the basic detail-phase exploration is completed. The cost effectiveness of the initial confirmatory drill hole will be a maximum when land acquisition is followed by a supplemental detail-phase program, but this approach does not lead to the highest expected return on investment.

GEOPHYSICAL TECHNIQUES AND SURVEYS

32930 Geochemistry of thermal springs of Tuscany (Italy). Benchini, A.; Duchi, V.; Martini, M. (Univ. of Florence). *Chem. Geol.;* **19**: No. 3, 229-252(Apr 1977).

Seventy-seven thermal springs, spread over an area of about 23,000 km^2, including the geothermal field of Larderello, were studied. Temperature and fundamental chemical composition, as well as distribution of several minor constituents (Li, Rb, Sr, F, Br, H_3BO_3, SiO_2) were taken into account in order to distinguish some principal hydrochemical types. Relationships between geological situation and water chemistry were investigated and a genetic model of the regional geology proposed.

32931 Geothermal investigations in Czechoslovakia 1974-1975: preliminary report. Cermak, V. (Geophys. Inst., Prague); Kresl, M.; Lizon, I.; Marusiak, I.; Vesely, I. *Publ. Inst. Geophys., Pol. Acad. Sci.;* **A-3**: No. 103, 13-25(1977).

New heat flow data collected during 1974 and 1975, as well as the corresponding temperature versus depth profiles for Czechoslovakia are discussed, and a preliminary heat flow map is drafted, based on these data. The heat flow patterns are analyzed on the basis of their relation to the tectonic setting in each instance, including major units such as the Bohemian Massif, the Carpathian Foredeep, and the Western Carpathians. The heat flow is obviously related to the tectonic setting, with increased heat flow corresponding to local elevation of the Mohorovicic discontinuity and tectonic instability. There is a general increase in heat flow from the outer zones of the Carpathian belt toward the inner structural units. A marked increase occurs along a northeast trend across the Carpathian Foredeep. Twenty-four references are provided.

GEOCHEMICAL TECHNIQUES AND SURVEYS

32932 (LBL—7019) **Extensive geochemical studies in the geothermal field of Cerro Prieto, Mexico.** Manon, A.; Mazor, E.; Jimenez, M.; Sanchez, A.; Fausto, J.; Zenizo, C. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 116p. Dep. NTIS, PC A06/MF A01.

Data collected during 12 years of operation of the chemical laboratory at Cerro Prieto are presented. These data include analyses of dissolved ions and gases in exploration and production wells and in thermal springs, as observed in repeatedly collected samples and measurements of wellhead and separator pressures, flow of steam and water and size of orifice, condition of well, etc., at the time of chemical sampling. The discussion in Part I is intended to illustrate graphically the geochemical pattern of the Cerro Prieto fluids, to search for ion correlations, and to provide a preliminary discussion of a small number of topics. The figures and tables in Part II provide the bulk of information in the report. (JGB)

EXPLORATORY DRILLING AND WELL LOGGING

32933 (LA-UR—78-707) **Hot dry rock, an alternate geothermal energy resource: a challenge for instrumentation.** Dennis, B.R.; Horton, E.H. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 14p. (CONF-780503—8). Dep. NTIS, PC A02/MF A01.

From 24. international instrumentation symposium; Albuquerque, NM, USA (1 May 1978).

The natural internal heat from the Earth is one of the cleanest, nearly inexhaustible energy sources. The hot dry rock that composes most of the Earth's crust has the potential of becoming one of the largest reservoirs of energy economically available in the near future. The Los Alamos Scientific Laboratory, for the past five years, has been working toward exploiting this very abundant, clean energy source. The LASL technique to demonstrate the technical and economic feasibility of extracting heat from the hot dry rock source depends upon the connection of two deep boreholes drilled into impermeable precambrian granite where the temperature approaches 200°C. The boreholes are connected by a system of hydraulic-produced fractures. Cold water flowing down the deeper hole will be heated by the hot rock and will be brought to the surface through the second hole. The hot water will be circulated through a closed-loop heat exchanger. The first phase of operating the 10 MW(t) heat extraction experiment will be conducted to determine the mechanical, physical and chemical properties of the reservoir and heat exchange system. Environmental effects will be carefully monitored. For optimum extraction of energy from this man-made geothermal reservoir, it is vital that the absolute location of the fractured system be well established. Fracture mapping techniques include an array of downhole instrumentation that must survive the hostile environment of the deep hot boreholes.

ECONOMIC AND FINANCIAL ASPECTS

REFER ALSO TO CITATION(S) 32929

ENVIRONMENTAL ASPECTS AND WASTE DISPOSAL

REFER ALSO TO CITATION(S) 33173

32934 (UCRL—52196) **Potential effects of geothermal energy conversion on Imperial Valley ecosystems.** Shinn, J.H. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Dec 1976. Contract W-7405-ENG-48. 83p. Dep. NTIS, PC A05/MF A01.

This workshop on potential effcts of geothermal energy conversion on the ecology of Imperial Valley brought together personnel of Lawrence Livermore Laboratory and many collaborators under the sponsorship of the ERDA Imperial Valley Environmental Project (IVEP). The LLL Integrated Assessment Team identified the electric power potential and its associated effluents, discharges, subsidence, water requirements, land use, and noise. The Working Groups addressed the ecological problems. Water resource management problems include forces on water use, irrigation methods and water use for crops, water production, and water allocation. Agricultural problems are the contamination of edible crops and the reclamation of soil. A strategy is discussed for predevelopment baseline data and for identification of source term tracers. Wildlife resources might be threatened by habitat destruction, powerline impacts, noise and disturbance effects, gas emissions, and secondary impacts such as population pressure. Aquatic ecosystems in both the Salton Sea and fresh waters have potential hazards of salinity and trace metal effects, as well as existing stresses; baseline and bioassay studies are discussed. Problems from air pollution resulting from geothermal resource development might occur, particularly to vegetation and pollinator insects. Conversion of injury data to predicted economic damage isneeded. Finally, Imperial Valley desert ecosystems might be threatened by destruction of habitat and the possible effects on community structure such as those resulting from brine spills.

32935 Mercury emissions from geothermal power plants. Robertson, D.E.; Crecelius, E.A.; Fruchter, J.S.; Ludwick, J.D. (Battelle Pacific Northwest Labs., Richland, WA). *Science;* **196**: No. 4294, 1094-1097(3 Jun 1977).

Geothermal steam used for power production contains significant quantities of volatile mercury. Much of this mercury escapes to the atmosphere as elemental mercury vapor in cooling tower exhausts. Mercury emissions from geothermal power plants, on a per megawatt (electric) basis, are comparable to releases from coal-fired power plants.

GEOTHERMAL POWER PLANTS

POWER PLANT SYSTEMS AND COMPONENTS

REFER ALSO TO CITATION(S) 32940

32936 Working fluids and systems for recovering geothermal or waste heat. Hutchinson, A.J.L. (to Geothermal Investment Co.). US Patent 4,057,964. 15 Nov 1977. Filed date 24 Aug 1976. 8p.

Energy is efficiently extracted from geothermal wells by flashing a portion of the hot fluid from the well into steam and using the steam and the hot fluid to heat an operating fluid in a closed system. The temperature and pressure of the system are such that the operating fluid vaporizes and the fluid has sufficient superheat to avoid condensation when expended in a prime mover such as a gas expansion gas turbine that has at least 75% conversion efficiency. Additionally, the operating fluid as a vapor has a specific heat that is at least 50% of the specific heat of the operating fluid as a liquid over the temperature range of 100°F to 250°F under the operating pressures of the process. Instead of using the steam to heat an operating fluid, it may be applied directly to a steam turbine. Additionally the steam may be washed before application to the turbine.

GEOTHERMAL ENGINEERING

DRILLING TECHNOLOGY AND WELL HARDWARE

REFER ALSO TO CITATION(S) 32939

CORROSION, SCALING, AND MATERIALS DEVELOPMENT

32937 (UCID—17734) **Radiographic inspections at the Calipatria Geothermal Test Site.** Durbin, P.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Mar 1978. Contract W-7405-ENG-48. 9p. Dep. NTIS, PC A02/MF A01.

A report is given of radiographic inspections to estimate the extent of corrosion and scale buildup at the Geothermal Test Site in Calipatria, California. Radiation exposure techniques using ^{60}Co and ^{192}Ir isotopes were developed. Radiography safety procedures were established. Five radiographic evaluations were made of the Geothermal Test Site from May 1976 to February 1977. Estimations of scale buildup from radiographs of operating plant pipes, valves, and tanks correlated closely with our actual scale measurements from used plant sections.

RESERVOIR STIMULATION AND EXTRACTION TECHNOLOGY

32938 (LA—7151-MS) **Equipment develoment report: downhole fluid injector.** Archuleta, J.R.; Fink, C.F.; Kurtenbach, J. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1978. Contract W-7405-ENG-36. 27p. Dep. NTIS, PC A03/MF A01.

The development, design, fabrication, and operation of a tool used for injecting a discrete quantity of fluid (e.g. a dye) at a desired location within a hot geothermal borehole are described. Assembly and operating instructions are included.

32939 (LA-UR—78-548) **Anomalous fracture-extension pressure in granitic rocks.** Aamodt, R.L.; Potter, R.M. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 24p. (CONF-780509—3). Dep. NTIS, PC A02/MF A01.

From 19. symposium on rock mechanics; Lake Tahoe, NV, USA (1 May 1978).

Portions of document are illegible.

Fracture-extension pressures appreciably higher than the least principal earth-stress were observed in hydraulic fractures formed in a pair of 3 km (9600 ft) deep boreholes drilled near the Valles Caldera in northern New Mexico. Pressurization of open wellbores in rock containing preexisting fractures may open these fractures, instead of creating new fractures at right angles to the least principal stress. The pressure necessary to flow into these fractures may be appreciably higher than the least principal stress. Upon sand-propping one such pre-existing fracture, a lower fracture extension pressure was observed. A second fracture in a parallel well-bore 92 m (300 ft) away, at the same depth of 2 km (6500 ft) exhibited the lower fracture extension pressure without propping, but with about 90° difference in fracture direction. Fractures created through perforations at a depth of 3 km (9600 ft) not only exhibited breakdown pressures upon initial pressurization, but sometimes even higher "breakdown" pressures upon repressurization. These phenomena may be of interest in the interpretation of earth stress measurements made by hydraulic fracturing.

32940 **Process for heating a fluid in a geothermal formation.** Arnold, G.B. (to Texaco Inc.). US Patent 4,060,988. 6 Dec 1977. Filed date 21 Apr 1975. 12p.

An in situ heat exchange process was developed for heating an organic fluid, which can be, for example, a normally liquid hydrocarbon having from 4 to 10 carbon atoms, in a geothermal reservoir formation penetrated by an injection well and a production well. The fluid is injected into the formation via the injection well, forcing the fluid through the formation with simultaneous heating and finally recovering the heated fluid via the production well. Utilizing heat exchangers at the surface, the heated fluid may be employed to supply process heating requirements for such diverse operations as preheating of refinery streams as exemplified by crude oil feed to distillation units, for salt evaporation, etc. or the heated fluid, preferably after removal of any brine derived from the geothermal formation, may be employed in gaseous form to operate turbine generators.

32941 **Secondary recovery method for the extraction of geothermal energy.** Bodvarsson, G.; Hanson, J. (Oregon State Univ., Corvallis). *EOS, Trans., Am. Geophys. Union;* **58**: No. 3, 165(Mar 1977).

DIRECT ENERGY UTILIZATION

REFER ALSO TO CITATION(S) 32940

32942 **Non-electrical uses of geothermal energy.** Barbier, E.; Fanelli, M. (National Research Council, Pisa, Italy). *Prog. Energy Combust. Sci.;* **3**: No. 2, 73-103(1977).

The non-electric applications of geothermal energy, with the exception of balneology, date back to the nineteenth century and have been given a new impetus by the recent oil crisis. In general, water or water—steam mixtures at temperatures between 20 and 180°C are used for these applications. The search for geothermal fluids draws on techniques from hydrogeology, geochemistry and geophysics, the same techniques as applied to the search for cold waters, together with some specific methods connected with the underground thermal conditions. Geothermal energy is used in agriculture, aquaculture, district heating and cooling, and various industrial applications. The power associated with these uses throughout the world at present can be estimated at 6200 MW and future prospects are by now promising and of definite economic interest. The environmental impact from geothermal energy is lower than that caused by conventional energy sources. Reinjection of used fluids back into the underground may, however, solve pollution problems.

GEOTHERMAL DATA AND THEORY

32943 **Comments on the effect of past climatic changes on the underground temperature field.** Cermak, V. (Geophys. Inst., Prague). *Publ. Inst. Geophys., Pol. Acad. Sci.;* **A-3**: No. 103, 45-56(1977).

A discussion is presented of the effects of paleoclimatic changes on the underground temperature field. Atmospheric temperature variations may have influenced the present temperature gradient in the crust, thereby affecting the calculated heat flow. Consequently, it is necessary to have a reasonably reliable method of introducing corrections to the calculations. Several simple examples of the surface temperature change and the subterranean response are given. Using published paleoclimatic data, temperature/time step-models are constructed and their effect on measured heat flow is evaluated.

32944 **Preparation of the heat flow map of the KAPG countries: final report.** Cermak, V. (Geophys. Inst., Prague); Stegena, L. *Publ. Inst. Geophys., Pol. Acad. Sci.;* **A-3**: No. 103, 3-11(1977).

More than 800 heat flow data from Central and Eastern Europe were used in the preparation of a surface heat flow distribution map. This work was performed under the multilateral cooperation of the Soviet, Warsaw Pact, and other Eastern European countries within the Commission for Planetary Geophysical Investigation, Working Group on Geothermics. The data used and the general characteristics of the map prepared are described. Those geological implications of the heat flow distribution which are readily discernible are discussed. Characteristic deep-crustal profiles were calculated for several provinces using data obtained from seismic surveys and models of the crustal distribution of radioactive heat production and thermal conductivities. Fifty-three references are provided.

ISOTOPE AND TRACE ELEMENT STUDIES

32945 **Geothermometry of spinel lherzolites.** Mori, T. (Australian National Univ., Canberra). *Contrib. Mineral. Petrol.;* **59**: No. 3, 261-279(1977).

Three methods of geothermometry, currently used for spinel lherzolites, are refined based on new experiments on subsolidus phase equilibria of olivine, pyroxenes, and spinel in CaO—MgO—Al_2O_3—SiO_2 and natural rock systems at 16 kb and 1200°C. Although quasi-thermodynamic modelling is employed, the methods are essentially based on the pyroxene solvus, alumina contents in clinopyroxene and orthopyroxene. Increasing alumina contents in pyroxenes reduce enstatite and diopside components in clinopyroxene and orthopyroxene, respectively. Thus, neglect of alumina in pyroxenes causes underestimates of temperatures by the solvus method. The three geothermometers were tested by applying them to homogeneous spinel lherzolites which were especially selected for this purpose. Coincidence of the three temperatures thus estimated gives confidence in the effectiveness of the geothermometers. They were also applied to spinel lherzolite nodules in basalts and intrusive lherzolites described in the literature. It was found that equilibration temperature of the nodules varies from 1000°C to 1300°C, i.e., temperatures somewhat higher than have been generally thought. In contrast to the nodules, the intrusive spinel lherzolites show extensive disequilibrium, which is probably due to retrogressive metamorphism suffered by the intrusives.

32946 **Calcite-dolomite geothermometry for iron-bearing carbonates: the Glockner area of the Tauern Window, Austria.** Bickle, M.J.; Powell, R. (Univ. of Leeds, Eng.). *Contrib. Mineral. Petrol.;* **59**: No. 3, 281-292(1977).

The effect of the addition of iron on the calcite-dolomite solvus in the system $CaCO_3$—$MgCO_3$ is predicted from an approxi-

mate thermodynamic description of the systems $CaCO_3$—$MgCO_3$ and $CaCO_3$—$FeCO_3$. Coexisting calcites and dolomites in 15 samples from the Glockner area of the Tauern Window were analysed to estimate metamorphic temperatures. These range from about 410°C at the top of the Matrei Zone, on the southern margin of the Tauern Window, to about 490°C at Hochtor in the centre of the Glockner Depression, implying a geothermal gradient of about 25°C/km during metamorphism.

TIDAL POWER

REFER ALSO TO CITATION(S) 32927

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33761

TIDAL POWER PLANTS

DESIGN AND OPERATION

32947 **Transducer for conversion of tidal current energy.** Ootsu, F. US Patent 4,071,305. 31 Jan 1978. Filed date 13 Oct 1976. 8p.

A set of aligned transducer units is fixedly disposed in the sea. Each unit includes two atmosphere compartments on the opposite end portions so that a seawater stream created by tidal current flowing through its lower portion between the compartments drive an impeller disposed between the compartments. The sea water stream rotating the impeller actuates air cylinders disposed in both atmosphere compartments communicating with the atmosphere. The air cylinders compress the air to produce high pressure air. This high pressure air from all the cylinders is transported through a common pipe to an adjacent shore where it may be converted into electrical energy. A ballast water room with its control is connected to the underside of the transducer set for floating and sinking the apparatus.

WAVE ENERGY CONVERTERS

32948 **Wave motor.** Welczer, M. US Patent 4,076,463. 28 Feb 1978. Filed date 26 Oct 1976. 6p.

A wave motor is described comprising a cylinder fixed to a first float, a plunger fixed to a second float, and an anchor secured to the cylinder normally retaining same submerged beneath the sea surface in a vertical position above the sea bottom but permitting it to move in a lateral direction with respect to the sea bottom. The second float is of sufficient volume to float on the surface of the sea, whereby wave crests and wave troughs cause the cylinder to move laterally and the plunger to rise and fall within the cylinder, thereby converting the wave energy to mechanical pumping energy.

32949 **Dual wave motion pump.** Pinney, P.E. US Patent 4,076,464. 28 Feb 1978. Filed date 24 Jan 1977. 6p.

An apparatus is described for the conversion of complex surface motion of the sea or other fluid body into useful energy, comprising a pair of floating bodies, each of which constitutes a wave motion pump; the pair of floating bodies being linked by a lever whose motion serves to initiate and multiply the pumping energy of each. Each floating body contains two piston operated water cylinders with water intake check valves at their bases and a third cylinder serving as a pressure chamber. Each floating body contains its own fulcrum such that it rocks about one end of the lever. The downward pivotal motion of the lever on the piston shaft of the piston in one of said water cylinders forces water out of the cylinder. Simultaneously, the upward motion of the lever on the other side of the fulcrum pulse the piston shaft of the other piston upward, causing water to be taken into the other cylinder through the intake check valve at its base. As the action of the lever reverses, the action of the pistons reverses, causing a constant flow of water under pressure into the pressure chamber from which it exhausts. The same sequence of events occurs in the second floating body, thus causing the effect of a dual pump. Air pressure is utilized to reinforce this process. Since the apparatus has four cylinders alternately and sequentially forcing water through defined channels, the effect of an efficient pump is created, which might be utilized for any normal purpose.

32950 **Wave-action power apparatus.** Tornabene, M.G. US Patent 4,073,142. 14 Feb 1978. Filed date 16 May 1975. 8p.

In a preferred embodiment of the invention, a series of off-set rows of spaced-apart upwardly and downwardly reciprocatable floats are mountedly positioned with predetermined distances and positions relative to one another such that radially-outwardly traveling turbulances resulting from upward and downward reciprocation of the floats coincide with one-another and with current and/or wave water forces to result in amplified strokes of reciprocation of the floats, and the process of subjecting the floats to such forces, and pooling the energy of a plurality of such floats into a common driving force.

WIND ENERGY

ECONOMICS

32951 (AED-Conf—77-139-004) **Wind power.** Huetter, U. (Stuttgart Univ. (TH) (Germany, F.R.). Inst. fuer Flugzenugbau). 1977. 4p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Energy policies forum; Stuttgart, West Germany (9 May 1977).

A survey is presented of the possibilities to utilize wind power. In the FRG, wind power plants could meet about 70% of the electricity demand (approximately 200 TWh) on the basis of figures of 1973. Interconnected operation between wind power converters and solar energy collectors for supplying remote properties or villages seems particularly promising, too.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33761

32952 (NSF/RA—77-0026) **Public reactions to wind energy devices. Final report.** (Illinois Univ., Urbana (USA). Survey Research Lab.). Oct 1977. 215p. Dep. NTIS, PC A10/MF A01.

This study was undertaken by the Survey Research Laboratory of the University of Illinois to explore reactions of the general public toward different types of wind energy devices for generating electric energy. More specifically, the objectives of the study were twofold: to provide substantive information on public acceptance of different types of wind energy devices in different settings; and to furnish a methodological base for more intensive studies of public acceptance of such devices. The study was carried out by conducting personal interviews with statistical random samples of adults in six different parts of the country, with primary emphasis on rural and smaller urban areas. The locations selected were western Michigan, southeastern Wyoming, western Washington, eastern Rhode Island, the Chicago area, and the Sandy Hook Unit of the Gateway National Recreation Area in New Jersey. Those interviewed were questioned on a number of topics, including their attitudes toward sources of energy, their knowledge of wind energy devices, and their opinions on paying extra for pollution-free sources of energy. In addition, they were shown slides of different wind energy machines in various settings and were asked to indicate their preferences from an aesthetic point of view.

WIND ENERGY ENGINEERING

TURBINE DESIGN AND OPERATION

32953 (SAND—74-0386) **Addendum to a proposal to NSF to sponsor a vertical-axis wind turbine research program.** Blackwell, B.F.; Feltz, L.V.; Rightley, E.C. (Sandia Labs., Albuquerque, N.Mex. (USA)). Nov 1974. Contract EY-76-C-04-0789. 34p. Dep. NTIS, PC A03/MF A01.

Information is presented concerning the performance evaluation of a 15 foot-diameter test bed Darrieus rotor, Darrieus rotor wind tunnel tests, Savonius rotor wind tunnel tests, blade manufacturing techniques for 15 foot-diameter and 35 foot-diameter wind turbines, static and dynamic structural analysis, production prototype design of a 15 foot-diameter turbine, production prototype design of 35 foot-diameter turbine, and aerodynamic performance studies.

32954 **Harnessing the wind.** Yen, J.T. (Grumman Aerospace Corp., Bethpage, NY). *IEEE Spectrum;* **15**: No. 3, 42-47(Mar 1978).

Various types of wind turbines are compared. Economic aspects of wind turbines are considered. Special attention is given to the tornado-type wind turbine.

32955 **Vortex wind power.** So, R.M.C. (General Electric Co., Schenectady, NY). *J. Fluids Eng.;* **100**: No. 1, 79-82(Mar 1978).

From Winter annual meeting of the American Society of Mechanical Engineers; Atlanta, GA, USA (27 Sep 1976).

An infinite viscous laminar vortex with no reverse flow region in the exit plane, but with axial inflow at the base, is analyzed. The axial inflow is assumed to be finite everywhere. From the analysis, the maximum wind power that can be obtained from such a vortex is calculated. The results show that the power developed depends on the circulation at infinity and on the viscous radius of the core of the vortex. The significance of this result, as it relates to the recently proposed vortex wind energy system, is discussed.

32956 Effect of hub fairings on wind turbine rotor performance. Wilson, R.E. (Oregon State Univ., Corvallis). *J. Fluids Eng.;* **100**: No. 1, 120-122(Mar 1978).

Hub fairings or spinners are frequently suggested for wind turbines for reasons of aesthetics or performance. While hub fairings rarely, if ever, decrease the appearance of a wind turbine, the effects of a nose fairing may actually decrease rather than increase wind turbine rotor performance. Analysis of hub fairings effects on wind turbine performance is presented.

32957 Apparatus for extracting energy from winds at significant height above the surface. Lois, L. US Patent 4,076,190. 28 Feb 1978. Filed date 30 Mar 1976. 6p.

A buoyant sail or wing tethered to a line an appreciable distance above the surface where the winds are at higher speed than at ground level is provided with wind velocity gradient sensing members to guide movement of the buoyant sail to the elevation of greatest wind velocity, the other end of the line is attached to an electric generator. A series of sails are utilized with one being retracted while at least one other sail is positioned to catch the wind away from the generator. The wings may have dividers to increase the amount of flow disruption of the wind and increase the drag coefficient and hence the amount of energy extracted, and a pulley system may be utilized in lieu of a single pass tether line.

32958 Wind power converter. Hudson, G.E. US Patent 4,074,951. 21 Feb 1978. Filed date 31 Jan 1977. 8p.

A wind power converter is described which comprises a pair of rotatable turbines with elongated curved blades disposed within a rotatable housing on axially parallel shafts, the curvature of the blades of one turbine being opposite to the curvature of the blades of the second turbine to that wind passing between the turbines will rotate the turbines in opposite directions; the housing comprising shaft-supporting sections at the ends of the turbines, lateral sections connecting the end sections, a pair of wind deflectors disposed between the end sections and extending from adjacent edges of the lateral sections toward the midpoint between the turbines and terminating approximately the same distance from each other as the distance between the turbine shafts, and a pivotally mounted vertically disposed vane extending from a portion of the housing opposite to the wind deflectors.

32959 Wind driven power plant. Kling, A. US Patent 4,073,516. 14 Feb 1978. Filed date 6 Jun 1975. 12p.

A tethered wind-driven floating power plant is described which includes a support body carrying at least one rotor assembly, a current generator coupled to the rotor and alignment assembly for aligning the rotor to face into the wind, a ground anchor and at least one captivating stay connecting the floating power plant to the anchor. The support body is hollow and gas-filled to carry its own weight as well as the weight of the rotor assembly, current generator and alignment assembly. The support body is connected to the captivating stay through a joint connection having three degrees of freedom. The rotors are gimbal-mounted, at a variable relative position with respect to the support body but in fixed positions relative to one another.

32960 Tornado-type wind turbine. Yen, J.T. (to Grumman Aerospace Corp.). US Patent 4,070,131. 24 Jan 1978. Filed date 20 Jan 1975. 8p.

Atmospheric wind is admitted tangentially into a vertically extending structure and directed against the interior curved surface of the structure to produce vortex flow. The structure is open ended and spaced from ground or connected to a ram-air subterranean tunnel. The vortex flow and corresponding low pressure core draws ambient and/or ram air into the bottom of the structure to drive a horizontal turbine.

ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 33210

POWER PLANTS AND POWER GENERATION

REFER ALSO TO CITATION(S) 33257, 33258, 33280, 33744

32961 Constitutional state and electricity. Concerning the power station ban of the higher administration court at Muenster. Horn, H.R. *Dtsch. Verwaltungsbl. Verwaltungsarch.;* **92**: No. 1, 13-19(Jan 1977). (In German).

The OVG at Muenster, too, has prohibited the construction of the largest coal power plant in the FRG, planned for Voerde. The 'TA Luft' (technical instruction air) was not taken as binding for the judgment, the court rather preferred (literally) 'to determine the declarative value of the emission values stipulated in the administrative regulation ('TA Luft') in connection with the interpretation of the law (BImSchG), and then to take this value into account when applying the law.' The judgment also includes, on purpose, the basic question of the 'verwaltungsrechtlicher Rechtsschutz' (administrative legal protection). The article discusses the problem of the 'administrative control density' and procedural and methodical aspects as well as basic legal considerations on judgment finding with the target 1) to find the preconditions for full recognition of the grounds upon which the judgment is based, and 2) to present on the basis of the aspects discussed by the court itself, that the Senate was unjustified in denying the licensing authority a margin for judgment.

32962 Bau, Ausruestung und Betrieb von Waermekraftwerken. (Construction, equipment, and operation of thermal power plants). Schuhmacher, A. (comp.) (Fachverband Dampfkessel-, Behaelter- und Rohrleitungsbau, Duesseldorf (Germany, F.R.)). Essen, Germany, F.R.; Vulkan-Verl. (1976). 40p. (In German).

This report summarizes the latest technical achievements in the fields of thermal power plants. The following topics are dealt with: 1) steam generators for large power plants; 2) firings for steam generators connected in series with gas turbines; 3) tendencies in the waste-product developments and their influences on designs of steam boilers; 4) quality assurance of pipelines for thermal power plants, from the producer's side; 5) corner pipe boilers as safety boilers; 6) calculation of deformation and stress of cylindric shells under any temperature; 7) strength-theoretical background of the new TRD 301 (technical rules for steam boilers; stat. part); and 8) views at the question of using ion-exchange or reversed-osmosis procedures in the preparation of boiler feedwater.

COOLING AND HEAT TRANSFER EQUIPMENT AND SYSTEMS

REFER ALSO TO CITATION(S) 32699

32963 (COO—2500-1) **Advanced dry cooling tower concept.** Curcio, J.; Giebler, M.; Glicksman, L.R; Rohsenow, W.M. (European American Committee on Reactor Physics; Massachusetts Inst. of Tech., Cambridge (USA). Heat Transfer Lab.). 30 Sep 1975. Contract EY-76-S-02-2500. 113p. Dep. NTIS, PC A06/MF A01.

The purpose of this year's work has been to develop a new dry cooling tower surface. The new surface utilizes a modification of film type packing in wet cooling towers. It is a concept which may eliminate excessive water loss. Cost of fabrication, and effectiveness of heat transfer surface were among the major design considerations. Based on preliminary water wetting investigations over simple geometric surfaces, a conductive plate was shaped to form a series of V-troughs. It provided open channeled water flow separated by fin-like dry surfaces, and simultaneously self distributed random spraying water. The design not only channels the water flow, but also provides a convenient means to vary the air-water interfacial area to the water-plate and dry plate contact area. Varying these ratios will become necessary as optimization studies are completed. To investigate the effectiveness of this design and of future advanced wet-dry concepts, a model heat transfer test apparatus was constructed. It provided operating conditions (water temperature, water flow rates and air flow rates) similar to those of existing wet cooling tower packing sections. All of the design requirements have been satisfied: hot water flow recirculation and counter flow air stream. A computer simulation of the proposed surface was made. The simulation modeled heat and mass transfer from the air-water interface as well as heat transfer from the dry surface area. Initial parametric runs were made using the program. They indicate that when the ratio of wet surface area to total surface area is 5 percent, approximately 75 percent of the energy transfer takes place as sensible heat transfer; whereas, for a wet tower at similar conditions approximately 85 percent of the total energy transfer takes place by evaporation.

32964 Air—vapor dynamics in large-scale atmospheric spray cooling systems. Chaturvedi, S.; Porter, R.W. (Illinois Inst. of Tech., Chicago). *J. Fluids Eng.;* **100**: No. 1, 65-72(Mar 1978).

From Annual meeting of the Americal Society of mechanical engineers; Atlanta, GA, USA (Mar 1977).

Atmospheric spray cooling systems are alternatives to cooling towers and cooling ponds. A quantity Number of Transfer Units (NTU) containing the spray drop-wise parameters allows prediction of cooling range if local wet-bulb temperature is known. The essential problem is predicting local wet-bulb proceeding windward through the spray field. Theory was developed for this purpose

involving wind attenuation and turbulent diffusion. Experiments were performed on a large flow-through spray canal involving segments with two types of floating spray modules. Previous experimental data are available for a fixed manifolded spray pond. A comparison of theory and experiments shows reasonable agreement.

32965 **Use of cooling tower.** Szuecs, L.; Tasnadi, C.; Lindner, I. (to Komplex Nagyberendezesek Export-Import Vallalata, Budapest (Hungary)). German(FRG) Patent 1,501,393;B;. 25 Nov 1976. 6p. (In German).

The use of a cooling tower described should produce optimum heat exchange by not atomising the cooling liquid into droplets, but by using the surface tension in distributing it as a liquid film over as large a surface as possible. In this, the water jet to be cooled is taken horizontally to the underside of a slightly inclined water distribution plate. This plate has many rods, wires or bands hanging down vertically. The connection of these rods to the water distribution plate is arranged via a by-pass surface with suitable transition, so that the liquid film is distributed from the water distribution plate to all the rods, wets these continuously and flows downward smoothly. The heat transfer coefficient should be higher by several orders of magnitude than for other uses of cooling towers.

32966 (AD—045069) **Merkel theory of evaporative cooling.** Haussler, W.; Stadt, K. Translated from *Energietechnik;* **21**: No. 5, 200-205(May 1976). 26p. (FTD-ID(RS)I—0331-77). NTIS PC A03/MF A01.

No abstract available.

POWER CYCLES

REFER ALSO TO CITATION(S) 32568, 32579

32967 (CONF-770447—P1, pp 125-140) **Evaluation study of a pressurized—fluidized bed combustion (PFCB) combined cycle power plant concept design: a status report.** Huber, D.A. (Burns and Roe Industrial Services Corp., Paramus, NJ). 1977.

From Fluidized-bed combustion technology exchange workshop; Reston, VA, USA (13 Apr 1977).

In Proceedings of the fluidized bed combustion technology exchange workshop. Volume I.

The overall objective is to prepare a conceptual design for an electric power generating plant that will directly combust high-sulfur coal in a pressurized, fluidized-bed combustor in a combined gas/steam turbine cycle. The program includes the following specific objectives: To design a technically feasible, reliable and efficient combination of unit processes and equipment that will directly combust high-sulfur coal and produce electric power in an environmentally acceptable manner; and to project the capital, operating and product costs for a central station electric power generating plant. The size and operating mode were established for the reference Pressurized-Fluidized-Bed Combustion Combined Cycle Power Plant. The plant shall have a power rating of 500 to 600 MWe and shall be base loaded to optimize performance. Modularity and turndown capability are other primary considerations. Performance calculations were made for various cycle configurations. (A) Gas turbine with a waste heat boiler; (B) Gas turbine with exhaust firing in a waste heat boiler; (C) Gas turbine with reheat at power turbine inlet and a waste heat boiler; and (D) Gas turbine with reheat at low turbine inlet in conjunction with exhaust firing and a waste heat boiler. The results of the performance evaluations are summarized. For each of the cycles a preliminary screening capital cost and operating cost estimate was made. As a result of the performance data and the limited economic studies, Cycle B was selected as the cycle to be utilized in the study. This plant is based upon a combined gas turbine (UTC's FT-50 Engine) and steam turbine cycle. The gas turbine combustor is an air cooled pressurized-fluidized bed designed for coal firing. Exhaust from the gas turbine is fired in an atmospheric fluidized bed combustor to generate superheated steam for the "bottom" portion of the cycle.

COMPONENTS

32968 (AD—045104) **Brittle materials design, high temperature gas turbine. Volume I. Final report 1 Jul 71—30 Jun 76.** Bratton, R.J.; Miller, D.G. (Ford Motor Co., Dearborn, Mich. (USA)). Dec 1976. Contract DAAG46-71-C-0162,. 70p. NTIS PC A04/MF A01.

A highlight summary of the work conducted by Westinghouse from July 1971 to June 1976, on the Defense Advanced Research Projects Agency (DARPA) sponsored program, 'Brittle Materials Design, High Temperature Gas Turbines,' is presented. The Westinghouse portion of the program entitled, 'Stationary Turbine Project,' was concerned with the development of ceramic design and materials technology for large, electric, power-generating, combustion turbines. Major incentives for the use of ceramic components in these turbines include significant improvements in the overall efficiency of power conversion through higher operating temperatures and minimum cooling requirements and extended component life through greater resistance to corrosion/erosion with a variety of fuels. The first stage ceramic stator vane with associated support hardware was chosen as the principal developmental objective. A test demonstration of design concepts and materials feasibility was achieved in a high temperature static rig at a peak vane temperature of 2500 F. Two series of 100 duty cycle testing to represent peaking turbine operation at 0.8 turbine simulation were performed at 2200 and 2500 F, respectively. The three piece vane assembly design concept was confirmed as viable and hot pressed silicon nitride emerged as the best candidate ceramic material for structural turbine applications.

32969 (FE—2465-6) **Erosion study in turbomachinery affected by coal and ash particles. Phase I. Technical report.** Tabakoff, W.; Kotwal, R.; Hamed, A. (Cincinnati Univ., Ohio (USA). Dept. of Aerospace Engineering and Applied Mathematics). Apr 1978. Contract EX-76-C-01-2465. 11p. (CONF-780405—2). Dep. NTIS, PC A02/MF A01.

From 23. international gas turbine conference; London, UK (9 Apr 1978).

The test facilities designed thus far did not simulate the aerodynamic effect of the flow field over the erosion specimen. This effect can be a very important factor in turbomachine erosion, where the flow is constantly turned by rotating and stationary cascades. Two erosion test facilities were, therefore, built during the course of this study. The first wind tunnel with a stationary specimen was designed to obtain basic erosion data, particle impact, and rebound characteristics. Another unique test facility was then designed to simulate and measure the erosion of turbomachine blades. With the basic information developed in this test facility and the empirical relations derived therefrom, the necessary data are available to calculate the material removed by erosion. This, together with an analysis of particle trajectories in turbomachines, can be used in the prediction of erosion of the different turbine components by the ash particles.

32970 (FEI—603) **Technique for the calculation of the temperature field and efficiency of steam generators with cross-longitudinal coolant flow.** Yur'ev, Yu.S.; Efanov, A.D.; Kolmakov, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A technique is presented for calculating the mean coolant temperature at the given mean coolant distribution in the inter-tube volume of the steam generator-evaporator. The technique is based on integration of equations for energy distribution along the liquid flow tubes. A formula is obtained for the efficiency of a steam generator with an orbitrary coolant flow in comparison to that of a steam generator with uniform counterflow. Analytical formulae are presented for a particular case given for illustration. The proposed technique may be adopted for a more general problem of heat transfer with account for the economizer zone in the evaporator, and for thermal conductivity and coolant mixing effects.

32971 (UCRL—52390) **Ash fouling and erosion of silicon-based ceramic expanders in coal-fired power plants.** Taylor, R.W.; Shell, T.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Jan 1978. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

Lysholm-type helical-screw engines (expanders) are proposed as a means of generating electrical power from coal-fired power plants (topping cycle). Ash erosion and deposition (fouling) of silicon-based ceramic materials exposed to coal ash at topping-cycle temperatures (approximately 1270 K) was studied at the Lawrence Livermore Laboratory to select suitable expander materials. Silicon carbide (SiC) or silicon nitride (Si_3N_4) blocks exposed to an ash-injected flame at 1270°K fouled; however, fouling was prevented when blocks or wheels of the material were rubbed or spun against each other, simulating expander rotors. The sliding friction coefficient between contacting SiC or Si_3N_4 surfaces was 0.5 at room temperature, increased to 0.9 at 1270°K, but returned to approximately 0.5 when hot, soft ash was injected between the surfaces. When rubbed together, blocks of SiC wore 9.5 mg/h at topping temperatures, 25 times greater than at room temperature. Increase in wear with temperature likely occurs because the SiC surface oxidizes to soft and easily worn silicon oxide. The cooler, harder ash downstream of the expander outlet could erode plant boiler parts. In our tests, high-speed, hard fly ash particles eroded Si_3N_4 blocks at 0.2 to 1 mg per g ash at room temperature. This erosion rate is expected to decrease significantly with increasing temperature, particularly above the ash-softening temperature, 870°K. Relative to other ceramics and metals, SiC and Si_3N_4 are resistant to high temperatures, ash erosion, and fouling under simulated expander conditions and would be equally suitable materials for a topping-cycle Lysholm-type engine.

32972 **Maximum-likelihood parameter identification of low-order electric power plant models.** Herget, C.J. (Iowa State Univ., Ames); Park, C.U. pp 939-940 of Proceedings of the 1976 IEEE conference

on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

Results are presented of studies performed for the verification and parameter identification of a low-order power plant model from actual operating data. A model of a boiler based on physical principles and using actual data from a power plant is postulated, and the unknown parameters of the system are identified using a maximum likelihood identification algorithm.

32973 Contribution to calculation of changing stresses in turbine blades with different operating rotation numbers. Raschke, K. (Kraftwerk Union Aktienges, Muelheim, Ger). *Fortschr.-Ber. VDI Z., Reihe 4;* No. 37, 1-57(Jun 1975). (In German).

Detailed study of components is presented. Load distribution and vibrations are analyzed. Various calculation methods are suggested. 12 refs.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 33229

32974 Legal obstacles to industrial combined-cycle power plants. Ernst, H. *Energie;* **29**: No. 5, 126-128(May 1977). (In German).

Chances of combined-cycle systems in the industry are discussed with regard to legal restrictions in connection with a further reduction of the primary energy consumption. Mention is made of the wayleave law, the act for promoting the energy industry of 13.12.35, the act against restriction of competition and pricing, esp. the regulation on the prohibition of price rising of 26.11.36 and the Third Electricity Generation Act.

ECONOMICS

REFER ALSO TO CITATION(S) 32981

FUELS

REFER ALSO TO CITATION(S) 32579, 32692, 32701

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 32613, 33487, 33495, 33696, 33697, 33719, 33729, 33730, 33989, 33991, 34003, 34004

32975 (UCD—472-124, pp 192-194) **Impacts of heavy metals and radioactivity from coal combustion.** Goldman, M. Oct 1977.

In Annual report, fiscal year 1977.

Coal-fueled plants appear to have the potential for a slightly higher radiologic impact on the population than do nuclear-powered plants although in both cases the impact appears to be quite small. The additional impact from trace elements in and on respirable fly ash is of concern and should be factored into the total assessment of potential health consequences associated with a major increase in coal combustion. For some time the paucity of essential data will hamper realistic evaluations.

32976 Environmental impacts of energy facilities. Schwarz, K. (Verein Deutscher Ingenieure, Duesseldorf (Germany, F.R.). Kommission Reinhaltung der Luft). pp 6 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection. International congress on energy and environment; Duesseldorf, Germany, F.R. (8 Feb 1977).

Starting with a presentation of the overall influences of energy in the FRG, the individual environmental influencing sources of energy facilities are specified and recent developments of overall solid emission through industry are dealt with. Then environmental problems in connection with the conversion of primary energy in the form of fossil fuels into electric power is treated in more detail. Dealt with are the loads on air and water through fossil-fuel power plants, waste heat discharge, cooling systems and noise. Finally, the influences of power plant facilities on landscapes are illustrated.

NOXIOUS GAS AND PARTICULATE ABATEMENT AND CONTROL

REFER ALSO TO CITATION(S) 32616, 33575

32977 (ANL/ECT—1(Vol.2)) **Environmental control implications of generating electric power from coal. Technology status report. Volume II.** (Argonne National Lab., Ill. (USA)). Dec 1976. Contract W-31-109-ENG-38. 435p. Dep. NTIS, PC A19/MF A01.

This is the first in a series of reports evaluating environmental control technologies applicable to the coal-to-electricity process. The technologies are described and evaluated from an engineering and cost perspective based upon the best available information obtained from utility experience and development work in progress. Environmental control regulations and the health effects of pollutants are also reviewed. Emphasis is placed primarily upon technologies that are now in use. For SO_2 control, these include the use of low sulfur coal, cleaned coal, or flue-gas desulfurization systems. Electrostatic precipitators and fabric filters used for the control of particulate matter are analyzed, and combustion modifications for NO/sub x/ control are described. In each area, advanced technologies still in the development stage are described briefly and evaluated on the basis of current knowledge. Fluidized-bed combustion (FBC) is a near-term technology that is discussed extensively in the report. The potential for control of SO_2 and NO/sub x/ emissions by use of FBC is analyzed, as are the resulting solid waste disposal problems, cost estimates, and its potential applicability to electric utility systems. Volume II presents the detailed technology analyses complete with reference citations. This same material is given in condensed form in Volume I without references. A brief executive summary is also given in Volume I.

32978 (CONF-771219—3) **Prediction of limestone requirements for SO_2 emission control in atmospheric pressure fluidized-bed combustion.** Snyder, R.B.; Wilson, W.I.; Johnson, I. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

From 5. international conference on fluidized bed combustion; Washington, DC, USA (12 Dec 1977).

The limestone-SO_2 reactivity as determined on a thermogravimetric analyzer was used to estimate the quantity of limestone required to meet the SO_2 emission standard in atmospheric fluidized-bed coal combustors. Comparison of laboratory TGA calcium utilization with pilot plant experimental results were made. Estimates of SO_2 retention in a carbon burnup cell were made for various limestone feed options. From this information, estimates of limestone requirements for an AFBC-CBC system were made for Tymochtee dolomite and for Greer and Germany Valley limestones. The results indicate that dolomites may require smaller quantities to meet the SO_2 standard than limestones.

32979 Technology better than legislation. *Energie;* **29**: No. 7, 233-236(Jul 1977). (In German).

In connection with efficient environmental protection from coal-fired power plants, the efficiency of high stacks, efficient dust filter, and sound-insulation systems are discussed. It is pointed out that natural-draught wet cooling towers are particularly suitable for coal-fired power plants. They meet all the technical and economic demands to be made with regard to the environment.

32980 Measurability of emissions and retention possibilities of energy facilities. Thoenes, H.W. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.)). pp 9 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection. International congress on energy and environment; Duesseldorf, Germany, F.R. (8 Feb 1977).

A presentation of measuring methods for gaseous emissions and solid particle concentrations in exchaust gases of fossil fuel fired energy generation facilities, and of official guidelines for constantly recording emission measuring equipment, is followed by methods for lowering the emission of dust and noxious gases. Besides facilities for a gradual increase in flue gas desulfurization, technical combustion measures for lowering nitric oxides are presented, and methods for reducing the emission of anorganic halogen compounds are described.

32981 Approach to on-line power dispatch with ambient air pollution constraints. Chu, K.C.; Jamshidi, M.; Levitan, R.E. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). pp 261-266 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

An on-line optimal environmental/economic dispatch methodology for electric power generation is developed. Aside from the conventional economic dispatch, constraints on air quality are added to the minimum fuel cost problem. Using the integrated Gaussian puff model based on the statistical turbulent theory, rapid dynamic features of pollutant dispersion and its forecast surrounding the plants are emphasized. By applying a convex programming algorithm repeatedly, a set of marginal environmental imposts for the power plants at different times are obtained. Such imposts are incorporated with the fuel cost in the ordinary short-term economic

dispatching program to indirectly account for the environmental impact of power generation on the ambient air quality.

POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 33257, 33288

32982 (PNL—2616) **Electromagnetic compatibility, tropospheric and ionospheric aspects of SPS MPTS operations.** (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Mar 1978. Contract EW-78-I-06-1071. 40p. Dep. NTIS, PC A03/MF A01.

The results of a preliminary study of the effects of operation of a Solar Power Satellite (SPS) on the general performance of terrestrial and space based electromagnetic systems are given. In addition, the effects of a passing high energy Microwave Power Transmission System (MPTS) through the troposphere and through the ionosphere are also considered. The SPS as envisioned will be a satellite system in geosynchronous orbit with a solar array of about 144 square kilometers. The purpose of the SPS is to capture solar energy, convert the radiant energy to microwave energy and transmit it to the earth as a beam by means of a phased array antenna one kilometer in diameter at a frequency of 2.45 GHz. At the surface of the earth, the energy beam will be captured by an antenna about 100 square kilometers which will convert the microwave energy to high voltage ac power for injection into an electrical power network. The impact of SPS operation on the lower atmosphere, the ionosphere, and on operational telecommunication systems, is addressed in a preliminary manner. Topics include (a) further study on the susceptibility of electronic equipment to SPS emissions; (b) further study on the interference potential of SPS emissions and harmonics to electromagnetic systems; (c) study of the impact of tropospheric attenuation and scattering associated with SPS operation on microwave terrestrial, air/ground and satellite/ground telecommunication systems; (d) further theoretical study on the production of ionospheric irregularities resulting from microwave heating; and (e) further experimental evidence of the impact of SPS operation on the telecommunication system performance collected in conjunction with a Platteville microwave heating experiment.

32983 **Operating under stress and strain.** Fink, L.H.; Carlsen, K. *IEEE Spectrum;* **15**: No. 3, 48-53(Mar 1978).

Power system control objectives for various levels and types of emergencies, e.g., overloads, faults, frequency drop, equipment damage, control system failure, are defined. Normal system operation, emergency prevention, emergency control, and recovery from emergencies are discussed. The need for ongoing research in power system control and for a concerted effort to develop an approach to system planning, design, and operation that properly recognizes all the system operating states and the state-transition mechanisms is emphasized. (LCL)

32984 **Methods for the assessment of model networks for electric power supply.** *Elektrotech. Z., A;* **98**: No. 11, 728-734(Nov 1977). (In German).

For the study of 'High-power electricity transmission and distribution in densely populated areas' an investigation was made into how much consideration must be given in the assessment of electricity transmission systems to reliability of supply and protection of the environment, in addition to economic efficiency. While the capital-value method is a proven procedure, there are encouraging results available on the significance of the reliability analysis and the effectiveness analysis, but there is not yet sufficient experience for general agreement. 4 figs., 4 tables, 6 refs.

32985 **Technical and economic data of HVAC and HVDC stations.** *Elektrotech. Z., A;* **98**: No. 11, 721-727(Nov 1977). (In German).

For the study of 'High-power electricity transmission and distribution in densely populated areas' technical and economic data were collected from HVAC und HVDC stations. The summarized presentation of the present state of development and of future realistic probabilities from similar points of view showed, even within the framework of the overall study, that for the construction of large transformers there are no basic new problems to be solved; in the case of switching installations the rated currents for branches and busbars have still to be matched to the future requirements of heavy-current technique, and that further efforts have to be made to improve the compactness of convertor stations for use in densely populated areas.

32986 **Power transmission from power plants to densely populated areas.** *Elektrotech. Z., A;* **98**: No. 11, 735-739(Nov 1977). (In German).

For the study of 'High-power electricity transmission and distribution in densely populated areas' an investigation was made on the basis of the technical and economic data worked out for individual apparatus in a.c. and d.c. techniques on the transmission model of power-station feed-in into densely populated areas with one or several centers. The comparative consideration deals with transmission using overhead and underground lines in HVAC and HVDC techniques with the transmission voltages 380, 750 and 1,150 kV a.c. and +- 200 (only for superconductor cables) +- 400 and +- 600 kV d.c. Transmitted powers of 2,500 and 10,000 MVA or 2,250 and 9,000 MW over distances of 10 to 100 km are used as a basis.

32987 **Model networks for the supply of multi-centre densely populated areas.** *Elektrotech. Z., A;* **98**: No. 11, 748-754(Nov 1977). (In German).

For the study 'High-power electricity transmission and distribution in densely populated areas', on the basis of technical and economic data for individual apparatus in a.c. and d.c. techniques which had been worked out, an investigation was made on a model network of a multi-center densely populated area. The comparative consideration covers transmission systems with overhead and underground lines in HVAC and HVDC techniques with the principal rated transmission voltages of 380 and +- 400 kV. In the case of the underground transmission models solutions using internally-cooled oil cables are compared with solutions having additional superconducting cables for 220, 380 and +- 200 kV.

32988 **Model areas for densely populated areas in the Federal Republic of Germany.** *Elektrotech. Z., A;* **98**: No. 11, 740-742(Nov 1977). (In German).

On the basis of the densely populated areas at present existing in the Federal Republic of Germany, representative model areas for large cities and concentration regions were developed for the study 'Electric high-power transmission and distribution in densely populated areas'. The estimation of future developments and also the change in the built-up areas and also the possible load increases in these spaces led to load assumptions for about the year 2,000 on which the system designs could be based. The consideration of the possible power supply by power stations of increasing output indicates inter alia that supply of district heating is possible in the forseeable future only from power stations near to towns.

32989 **Electric high-power transmission in densely populated areas.** Rumpf, E. (Forschungsgemeinschaft fuer Hochspannungs- und Hochstromtechnik e.V., Mannheim (Germany, F.R.)). *Elektrotech. Z., A;* **98**: No. 11, 709-710(Nov 1977). (In German).

The target of the study 'electric high-power transmission and distribution in densely populated areas', initiated and sponsored in 1973 by the Federal Minister for Research and Technology, is to give decision aids for the importance and necessity of developing novel operational means for electric power transmission. In this contribution, the problems to be solved, the approach used and the realization of the study are outlined.

32990 **Ripple control, an economic supervisory system for consumer control.** Lennertz, H. (Brown, Boveri und Cie A.G., Mannheim (Germany, F.R.). Geschaeftsbereich Schaltanlagen und Installationen). *Elektrizitaetswirtschaft;* **76**: No. 21, 743-746(Oct 1977). (In German).

Ripple control installations for consumer supervision achieve high economic utilization of the installation investment for energy generation and distribution. On the basis of a model calculation the author makes a cost-profit analysis and demonstrates the profitability of ripple-control installations for controlling a power of a few megawatts. This result is of particular importance for medium-sized and small electricity supply undertakings. He reports on the increasing importance of selective load control with electronic ripple-control receivers, the reduction of load peaks by short-period switch-off of special types of consumers and the use of the process computer for dynamic load control with the ambit of system control technique.

32991 **Control and distribution of electrical energy as mirrored by the relevant VDE regulations.** Becker, E. (Metzenauer und Jung G.m.b.H., Wuppertal (Germany, F.R.)). *Elektrotechnik (Berlin);* **59**: No. 1/2, 16-18(Jan 1977). (In German).

The essay deals with the regulations issued by the VDE in the fields of electrical energy distribution and control on national and international level. Starting from an interesting historical survey the author deals with VDE stipulations, introduces new control systems and explains the latest switching units.

32992 **General-purpose power-system digital-control model that is insensitive to the initial state.** Hargrove, A. (Hampton Inst., VA). pp 63-68 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A new state variable matrix model of a multimachine power system is reviewed. Its sensitivity to the initial state variables is noted and a new controller using the Gradient Project Algorithm is

described. A unique feature is the insertion of an original algorithm again derived from the Gradient Projection method between the controller and the initial state input of the system assuring that the initial state will be accepted. The "general purpose" power system control model is so called because it handles a variety of problems.

32993 Optimal reliability and spare capacity in power system. Yousif, S.M. (California State Univ., Sacramento). pp 69-72 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A procedure is provided for evaluating optimal values for generation capacity and reliability of power systems. The reliability of a power system is defined in terms of loss of load probability, LOLP. The optimal procedure is based on maximizing the expected cost of system operation with respect to the generation energy capacity and then determining the LOLP value corresponding to the optimal capacity. This obtained value of LOLP is used to obtain the system generation and reserve capacities by utilizing the definition of LOLP and opting to probability approximation and assuming the power system is uniform.

32994 Multilevel approach to optimal interconnected power system dispatch. Spare, J.H. (Philadelphia Electric Co.); Shen, D.W.C. pp 241-246 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

The optimal power flow problem with tieline security constraints is formulated as a two-level optimization scheme for interconnected power systems. In contrast with other approximate methods, the exact overall power system equations are decomposed into first-level subsystems which correspond to individual company networks. The particular decomposition developed readily lends itself to the imposition of tieline security constraints by the second-level coordinator. Conditions for the optimal coordination of subsystems are formulated to require a minimal amount of data interchange. An efficient second-level coordination algorithm is developed to achieve the exact overall optimal power flow solution in a few iterations. This is illustrated by a few sample problems for a fully interconnected three subsystem network.

32995 Nonlinear branch and bound algorithm applied to optimal long-range power-system-transmission planning. Meliopoulos, A.P. (Georgia Inst. of Tech., Atlanta); Debs, A.S.; Webb, R.P.; Rindt, L.J. pp 255-260 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

A solution method to the problem of long range optimal expansion planning of an electric power transmission network is presented. The problem is formulated as a discrete-time deterministic optimal control problem. A nonlinear branch and bound solution method is developed. For a finite planning period, upper and lower bounds of the objective function are computed. Enumeration of the discrete controls is then bounded. The method proceeds by consistently narrowing the bounds until the optimal trajectory is isolated. The method provides a computationally efficient tool for determining an optimal expansion plan. The impact of the economy of scale and cost escalation is readily assessed.

32996 Handling dynamic uncertainties for electric power system modeling and control. Mostafa, O.M. (Texas A and M Univ., College Station). pp 267-271 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

An approach to treat partial dynamic uncertainties for purposes of electric power system monitoring and control is demonstrated. Stochastic modeling from real time measurements, and system parameter estimation techniques, are used to identify the unknown dynamics. Cases of dynamic uncertainties, often encountered in electric power system studies, and which are discussed involve: (1) electric load demand forecast, and/or system frequency prediction for purposes of system planning and automatic generation control; (2) dynamic characterization of electric loads or generators for different stability studies; and (3) equivalencing of unknown parts of partially specified networks for handling large scale system complexities, computational cost and storage limitations.

32997 (DOE-tr—86) **Possible power flux calculations using the digital computer BESM-6.** Schulz, W. Translated from *Energietechnik;* **25**: No. 7, 320-324(Jul 1975). 11p. Dep. NTIS, MF A01.

Portions of document are illegible.

In order to solve planning and operational problems for electrical networks, load flux calculations must be continuously performed. Therefore, various digital computer programs were designed for the BESM-6 computer. A number of network calculation programs used in practice are discussed. They are used to determine direct, technically feasible, optimum or special solutions of the power flux problem. The performance and the practical applications of these programs are described.

AC SYSTEMS, EHV AND UHV

32998 Technical and economic data for overhead lines in high-voltage a.c. and d.c. transmission. *Elektrotech. Z., A;* **98**: No. 11, 711-715(Nov 1977). (In German).

For the study of 'High-power electricity transmission and distribution in densely populated areas' technical and economic data were compiled for high-voltage alternating current and direct current transmission. A modification of the overhead lines for transmitting higher powers is possible as required by means of higher rated transmission voltages, larger conductor cross-sections and a larger number of circuits installed on each mast. For the use of larger partial conductor cross-sections and of bundle conductors with more than 4 partial conductors, and also to use voltages higher than 380 kV, development work is requisite from the points of view of construction, installation, insulators and fittings. Further possible developments result from the use of new materials such as plastic insulators which make possible the use of more versatile shapes for application in heavy pollution, particulary for direct current overhead lines. By using insulating crossarms the width of path can be considerably reduced. Economic efficiency investigations show even today higher cost for such techniques compared with lines of earlier construction.

DC SYSTEMS

REFER ALSO TO CITATION(S) 32998

SUPERCONDUCTING AND CRYOGENIC SYSTEMS

REFER ALSO TO CITATION(S) 33522

NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 33225, 33227

32999 (TID—8200-R37) **Nuclear reactors built, being built, or planned in the United States as of December 31, 1977.** (Department of Energy, Oak Ridge, Tenn. (USA). Technical Information Center). Mar 1978. 52p. Dep. NTIS, PC A04/MF A01.

Information is tabulated on nuclear reactor and critical assembly facilities in operation, shut down, under construction, or planned. The data include name, owner, location, type, power, and significant dates.

33000 Energy policy review. London; HMSO (1977). 49p.

This document was prepared by the Department of Energy to review United Kingdom energy prospects and policies as a background to future energy policy decisions. It is not intended as a statement of Government policy but exposes options and assists in developing informed discussion. It is preceded by a note by the Secretary of State for Energy which highlights some of the main policy issues and strategic choices. The Review falls under the following headings: energy policy; world energy prospects; United Kingdom prospects; social and broader economic considerations; environmental considerations; suggested long-term strategy; short term prospects; pricing and financial framework; organisation. The place of nuclear power in the economy is discussed, in relation to other energy sources.

33001 Energy or extinction. The case for nuclear energy. Hoyle, F. London; Heinemann Educational Books (1977). 81p.

A short account is given of stars and atoms and sources of energy. An estimate is made of the total energy flow needed for the whole world. The energy available from non-nuclear sources is examined and found to be insufficient, even if fully developed, to meet the needs. The basis of nuclear energy is outlined, and various problems connected with its use are discussed. It is concluded that in the present state of knowledge nuclear fission is the only adequate

realistic source of energy, though nuclear fusion may be developed later. It is argued that the CANDU type of reactor has advantages over the fast breeder reactor. The safety of nuclear energy is discussed and the risks are compared with other risks for which statistics exist.

33002 **Einsatzoptimierung von Waermekraftwerksbloecken mit beschraenkter Leistungsaenderungsgeschwindigkeit. (Operation optimization of thermal power plants with limited rate of power change).** Modemann, G. Muenchen, Germany, F.R.; Oldenbourg (1977). 108p.

In operating and planning power plants one faces the problem of size and volume of their rate of power change. Complex determination of economically optimal operation modes of power plant systems with regard to their restricted rate of power change is not possible with the help of the operation optimization methods known, in spite of reasonable expenses. This is why the solution of this problem is of increasing importance esp. within the framework of the increased efforts for standardization of large power plant units. The paper describes a new combination of known approaches to an efficient calculation model and represents an important contribution to the solution of the problem.

33003 **Atomy slouzi cloveku. Vyuziti jaderne energie v praxi. (Atoms serve man. Practical applications of nuclear energy).** Perina, F. Prague, Czechoslovakia; Prace (1976). 112p.

The fundamentals are presented in popular scientific form of the theory of nuclear reactors. The basic types thereof are described and their designs depicted, the basic parameters given and a brief description is presented of the first Czechoslovak nuclear power plant, the A-1, and of WWER nuclear power plants. Special attention is devoted to nuclear safety, to the economic aspects of nuclear power plants, the incorporation of nuclear power into existing power systems and the environmental impacts of nuclear power production.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, BOILING WATER COOLED

REFER ALSO TO CITATION(S) 33063, 33134, 33138, 33161, 33415

33004 (CONF-780304—8) **Thorium fuel cycles for LWRs: fuel diversion assessments and recycle requirements.** Carter, W.L.; Rainey, R.H.; Johnson, D.R. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From ANS - The Back End of the LWR Fuel Cycle; Savannah, GA, USA (19 Mar 1978).

A number of fuel cycles have been proposed for evaluation in the nonproliferation alternative systems assessment program. Among these systems are light water reactors (LWR) operating on the thorium-uranium cycle or the plutonium-thorium cycle either inside or outside energy centers. These proposals support the President's nuclear power policy of accelerating research into alternative fuel cycles that do not permit direct access to materials usable for nuclear weapons but still retain the benefits of nuclear power. Reprocessing and refabrication (often referred to as the "back cycle") constitute a portion of the overall fuel cycle and represent potential access points to fissionable materials, which, in many cases, may be in a rather attractive form for diversion. These operations for LWR thorium-uranium and plutonium-thorium fuels were analyzed to assess and rate the diversion or proliferation potential of each major operation. Reprocessing and refabrication evaluations per se constitute insufficient data for rating the acceptability of an entire fuel cycle and must be considered along with reactor analysis, environmental data, resource utilization, and political factors. Each back cycle operation has been evaluated according to needed development, material location, material description, convertibility and radiation hazard. Needed development relates to the state of the art of the operation and identifies the stage to which the development has progressed.

33005 (JAERI-M—6982) **Report on series 4 reflood experiment.** Murao, Y.; Iguchi, T.; Sudoh, T.; Sudo, Y.; Sugimoto, J. (Japan Atomic Energy Research Inst., Tokyo). Mar 1977. 44p. (In Japanese). Dep. NTIS (US Sales Only), PC A04/MF A01.

Series 4 reflood experiment was carried out from June to July 1976. The purpose was to examine system-pressure effect and system effect with heater rods having about the same heat capacity as the real ones and flow resistance of the primary loop. The results are: 1) The core flood velocity increases and the quench time decreases with system pressure. 2) The relation between core differential pressure (accumulation head of the core) and core power density, which indicates coolability of the core, is obtainable in map with the system pressure as a parameter. 3) The steady-state thermal condition occurs in the test section with constant power density.

33006 (JEN—372) **Boron concentration evolution in the temporary curtains of a BWR reactor. BURCUR code.** Cano Aguado, M.; Perlado Martin, J.M.; Minguez Torres, E. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 71p. Dep. NTIS (US Sales Only), PC A05/MF A01.

The theoretical model and the user's guide of the code BURCUR is included. This code analyzes the burnable poison concentration of the temporary curtains as a function of time, for BWR reactors of the 7 x 7 design. The computing time being reasonably short, the number of burnup steps is as high as necessary.

33007 (NEDO—21660) **Experience with BWR fuel through December 1976.** Elkins, R.B. (General Electric Co., San Jose, Calif. (USA). BWR Projects Dept.). Jul 1977. 31p. Electric Co., San Jose, CA.

The report provides an updated review of General Electric experience with production and developmental BWR Zircaloy-clad UO_2 fuel rods through December 31, 1976. The report concentrates on the most significant experience attained since September 1974 and the introduction of 8 x 8 fuel.

33008 (NUREG—0303) **Evaluation of the behavior of waterlogged fuel rod failures in LWRs.** Siegel, B. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Reactor Regulation). Nov 1977. 25p. NTIS $4.50.

A summary of the available information on waterlogged fuel rod failures is presented. The information includes experimental results from waterlogging tests in research reactors, observations of waterlogging failures in commercial reactors, and reactor vendor assessments. It is concluded that (a) operating restrictions to reduce pellet/cladding interactions also reduce the potential for waterlogging failures during transients, (b) tests to simulate accident conditions produced the worst waterlogging failures, and (c) there is no apparent threat from waterlogging failures to the overall coolability of the core or to safe reactor shutdown.

33009 (NUREG—0401) **Fuel failure detection in operating reactors.** Seigel, B.; Hagen, H.H. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Reactor Regulation). Dec 1977. 29p. NTIS $4.00.

Activity detectors in commercial BWRs and PWRs are examined to determine their capability to detect a small number of fuel rod failures during reactor operation. The off-gas system radiation monitor in a BWR and the letdown line radiation monitor in a PWR are calculated to have this capability, and events are cited that support this analysis. Other common detectors are found to be insensitive to small numbers of fuel failures. While adequate detectors exist for normal and transient operation, those detectors would not perform rapidly enough to be useful during accidents; in most accidents, however, primary system sensors (pressure, temperature, level) would provide adequate warning. Advanced methods of fuel failure detection are mentioned.

33010 (PNCT—831-75-02, pp 122-123) **Effect of spacer scrach and hydride on internal pressure burst properties of zircaloy-2 cladding tube.** Tsunoda, M.; Miura, M.; Watanabe, T.; Nagaki, H.; Noguchi, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1975.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jan—Jun 1975.

The effects of scratches on the behavior of absorbing hydrogen infiltrating into cladding tubes in an operating reactor were investigated. The purpose, procedure, and results of experiments are summarized in this report. Two types of zircaloy-2 cladding tubes (autoclave-treated tube and blank tube with 16.46 mm O.D., 14.70 mm I.D., and 0.87 mm thickness) with simulated scratches were subjected to hydrogen absorption by both gas flow and lithium hydroxide methods. The internal pressure burst test was made by hydraulic pressure at room temperature. To observe the absorption state of hydrogen and the condition of the burst section, a metallographic test was performed. The main results of those experiments are summarized as follows. (1) Shallow scratches (about one hundredth of wall thickness) did not affect directly the burst strength. (2) There is little difference in the burst strength between the two types of tubes tested. (3) For autoclave-treated tubes, the effects of scratches on the hydride segregation were observed, but there was no difference for blank tube. (4) Brittleness strongly affects on the burst behavior.

33011 (RISO—341) **Absorber management using burnable poisons.** Mortensen, L. (Risoe National Lab., Roskilde (Denmark)). Jun 1977. 125p. Dep. NTIS (US Sales Only), PC A07/MF A01.

An investigation of the problem of optimal control carried out by means of a two-dimensional model of a PWR reactor. A solution is found to the problem, and the possibility of achieving optimal control with burnable poisons such as boron, cadmium and gadolinium is discussed. Further, an attempt is made to solve the control problem of BWR, but no final solution is found.

33012 (XN—76-8-(NP)) **RODEX: fuel rod thermal mechanical response evaluation code.** Merckx, K.R. (Exxon Nuclear Co., Inc., Richland, Wash. (USA)). Dec 1977. 142p.

Fuel rod performance evaluation requires a calculational procedure that can take into account thermal hydraulic conditions, power distributions and histories, and deformations of the fuel rod cladding for a fuel rod. A computer code, RODEX, has been developed to perform these interactive calculations for a fuel rod under normal operational conditions. Besides the evaluation of thermal and mechanical conditions for normal operation, this code can be used to determine initial conditions for a fuel rod used in power ramping and accident analyses. The RODEX code incorporates a thermal-hydraulic model of the fuel rod in a flow channel, gas release, swelling, densification, and cracking models for the fuel, gap conductance and radial thermal conduction models, free volume and gas pressure calculations for the rod, and fuel and cladding deformational models. The calculations are performed on a time incremental basis with conditions being updated at each calculated increment. The documentation includes a description of the calculational models, a description of the calculational procedure, and results from bench mark and sensitivity calculations.

33013 Gueltigkeit und Anwendung von projektunabhaengigen Spezifikationen fuer Primaerkreiskomponenten von Leichtwasserreaktoren mit Standort Bundesrepublik Deutschland. Weisungsbeschluss 9. (Validity and application of project-independent specifications for primary circuit components of LWRs with site in the Federal Republic of Germany. Technical instructions 9). Essen, Germany, F.R.; VdTUeV (1976). 2p.

In the present decision of the TUeV-Leitstelle Kerntechnik, a validity period of two years is fixed for project-independent specifications which are subject to an examination by experts.

33014 Traglastuntersuchungen an Zylinderschalen aus Stahlbeton. (Load studies on cylindrical reinforced-concrete shells). Zerna, W.; Mungan, I.; Schmidt-Schleicher, H. (Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenieurbau). Opladen, Germany, F.R.; Westdeutscher Verl. (1976). 66p.

In a BWR reactor the pipes of the primary circuit conduct steam under pressure at a temperature of about 150 atmospheric excess pressure, so that the reinforced-concrete shell may be hit by a water-steam mixture with high load concentration in case of a pipe break. This load acts on the containment shell for about 20 to 25 seconds. As this would imply a catastrophic accident with low probability (MCA) and not a normal operational load, the containment is designed according to a limiting strength theory. The solution thus obtained guarantees both safety and economy.

POWER REACTORS, NON-BREEDING, LIGHT-WATER MODERATED, NON-BOILING WATER COOLED

REFER ALSO TO CITATION(S) 33004, 33008, 33009, 33012, 33064, 33097, 33098, 33099, 33122, 33123, 33138, 33139, 33161, 33163, 33165, 33415

33015 (BAW—10123) **Nuclear application software package.** Coiner, J.R.; Mamola, P.E.; Weimer, J.A. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Feb 1978. 90p. and Wilcox Co., Lynchburg, VA.

The Nuclear Application Software Package generates a full-core distribution and power peaking analysis every six minutes during reactor operation. Information for these calculations is provided by a set of fixed incore, self-powered rhodium detectors whose signals are monitored and averaged to obtain input for the software. Following the calculation of a power distribution and its normalization to a core heat balance, the maximum power peaks in the core and minimum DNBR are calculated. Additional routines are provided to calculate the core reactivity, future xenon concentrations, critical rod positions, and assembly isotopic concentrations.

33016 (CS-INIS—131) **Experience from welding LWR primary components.** Cerjak, H.; Debray, W.; Pellkofer, D. (Vyzkumny Ustav Zavodu Energetickeho Strojirenstvi, Brno-Slatina (Czechoslovakia)). 1976. 12p. (In Czech). Dep. NTIS (US Sales Only), PC A02/MF A01.

The flow chart is given of the process of manufacturing a reactor pressure vessel and of the main welded joint tests. The method of quality assurance is described in the production of rod electrodes for reactor component welding. Relaxation brittleness is discussed of steel due either to overheating the zone during welding or during annealing for stress relaxation. The mechanical properties were studied of steels 22 NiMoCr 3 7, and 20 MnMoNi 5 5 by tensile stress tests. The rods for tensile testing made of different materials with different structures were strained to a constant elongation of 0.2% at a temperature of 600 degC. The reduction of stress during straining was measured. The stress was found to decrease rapidly during 10 to 15 mins in all the tested materials and structures. The results are summed up in graphs.

33017 (GKSS—77/E/22) **Effects of the core grids on the burnout.** Katsaounis, A.; Fulfs, H.; Stein, M. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1977. 22p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This paper reports on burnout experiments carried out using freon 12 at four test sections with 6 x 6, 8 x 8, 7 x 7 rod bundles, and with annular geometries. The axial heat flux distribution of the heated rods is either uniform or simulating reactor conditions. For the rod bundle test sections original reactor grids of PWR type are used with mixing vanes or similar grids of PWR without vanes. For the annular test sections an orifice simulates the spacer. At all experiments without any expection the burnout occurs in front of a grid. The film boiling condition moves always from one front to the next front of a grid, but never just behind a grid.

33018 (IHZ-K—76-82) **Numerical calculations of the dependence of the spectral power density of ionization chamber noise of PWR type reactors on burnup.** Kunze, U. (Ingenieurhochschule Zittau (German Democratic Republic). Sektion Kraftwerksanlagenbau und Energieumwandlung). Aug 1976. 21p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

Results of numerical calculations are presented concerning the spectral power density of the neutron noise in the pwr type reactor WWER-2 Rheinsberg for the 1st and 6th campaign subjected to the burnup. The noise source is the fluctuation of the coolant temperature at the inlet. The calculations are based on a point model fitted by perturbation theory. A strong dependence of the peaks (until 10 Hz) from the concrete neutron flux is pointed out.

33019 (IHZ-K—76-83) **Direct method for calculating spectral densities of neutron flux fluctuations in PWR type reactors.** Meyer, K. (Ingenieurhochschule Zittau (German Democratic Republic). Sektion Kraftwerksanlagenbau und Energieumwandlung). Oct 1976. 10p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

An inhomogeneous partial differential equation for the calculation of cross spectral densities of fluctuations of the neutron flux is derived, in which the sources are the cross spectral densities of the noise sources.

33020 (IHZ-K—76-86) **Theoretical investigations of noise processes in PWR type reactors.** Kunze, U.; Meyer, K. (Ingenieurhochschule Zittau (German Democratic Republic). Sektion Kraftwerksanlagenbau und Energieumwandlung). Dec 1976. 14p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

A space-dependent one group model for the computation of the spectral densities for the fluctuations of the neutron flux due to statistical fluctuations of the reactor-parameters is presented. Furthermore, an ansatz is given for the treatment of fuel-element vibrations. Some numerical results are presented.

33021 (IHZ-K—77-91) **Methodical problems of basic education in nuclear engineering.** Meyer, K. (Ingenieurhochschule Zittau (German Democratic Republic). Sektion Kraftwerksanlagenbau und Energieumwandlung). Mar 1977. 11p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The correct use of the one-group diffusion equation for the treatment of thermal reactors (especially PWR type reactors) is outlined. It is shown, that mistakes in some standard textbooks lead to bad results. Straight forward methods for the treatment of standard problems result from an exact interpretation of the model.

33022 (NUREG—0258) **OCTAVIA computer code: PWR reactor pressure vessel failure probabilities due to operationally caused pressure transients.** Vesely, W.E.; Lynn, E.K.; Goldberg, F.F. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Nuclear Regulatory Research). Mar 1978. 46p. NTIS $4.50.

The OCTAVIA computer code has been developed to calculate the probability of pressure vessel failure from operationally caused pressure-transients which can occur in pressurized water reactors. The analysis approach involves calculation of vessel failure pressures using fracture mechanics methods and estimation of pressure-transient characteristics using historical nuclear data. Any of the parameters in the code can be modified for sensitivity analyses. The Surry 1 pressure vessel is analyzed as an example problem to demonstrate the code's capabilities.

33023 (TU-Inf—05-11-74) **Determination of gamma dose and neutron fluence during start-up of the Greifswald-1 reactor.** Prokert, K.; Doerschel, B.; Schuricht, V. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Sep 1974. 16p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

During start-up of the Greifswald-1 reactor gamma and neutron radiation was measured using activation probes and thermoluminescent detectors which provided more accurate results than

colorimetric dosemeters and solid state track detectors. A correlation was found between the n,γ field intensity and reactor power. The spatial distribution of the gamma dose and neutron fluence resulted in corresponding values. The spectral fluence distribution confirmed the existence of a soft neutron spectrum.

33024 (XN—75-27(Suppl.2)) **Exxon nuclear neutronics design methods for pressurized water reactors. Supplement 2.** Skogen, F.B.; Stout, R.B. (Exxon Nuclear Co., Inc., Richland, Wash. (USA)). 2 Dec 1977. 128p. Nuclear Co., Inc., Richland, WA.

Modifications to the Exxon Nuclear PWR neutronic design calculational methods are presented as well as the results obtained when these improved methods are compared to reactor measurements. The basic PWR design tools remain unchanged; i.e., the XPOSE code is used for generating the basic nuclear parameters, the PDQ-7 code is used for calculating reactivity and x-y power distributions, and the XTG code is used for three-dimensional analysis. The recent start-up experiences at D. C. Cook Unit 1 and H. B. Robinson Unit 2 have provided a significant increase in the data base supporting the current ENC PWR neutronic methods. The verification comparisons contained in the supplement include reactor measurements from D. C. Cook Unit 1, Cycle 2; H. B. Robinson Unit 2, Cycles 4 and 5; Palisades Cycle 2, and R. E. Ginna, Cycle 7.

33025 (ZfK—331) **Decomposition of noise signals composed of many similar components.** Grabner, A.; Liewers, P.; Schumann, P.; Weiss, F.P. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). May 1977. 18p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The interpretation of noise signals which are composed of many similar components from different noise sources is extremely difficult. By means of an experimental example the possibility of decomposition in the frequency and time domain is demonstrated.

33026 Motion restraining apparatus for a nuclear reactor. Jabsen, F.S. (to Babcock and Wilcox Co.). US Patent 4,072,564. 7 Feb 1978. Filed date 24 Sep 1976. 8p.

A typical embodiment of the invention provides a means for restraining the fuel elements within a nuclear reactor core from movement during reactor operation. Illustratively, within one of the fuel element end fittings a rectangular grid of torsion bars is positioned with the ends of each of the bars anchored in opposing parallel sides of the end fitting. Individual torsion arms fastened to the midportion of each of the respective torsion bars protrude above the end fitting to bear against the adjacent grid pads and thereby restrain motion in the direction of coolant flow. In the opposite fuel element end fitting a tube that extends through the length of the fuel element is connected to the center of a convex spring. The two ends of the spring are hinged to respective locking bars that are cammed to move in a direction that is transverse to the axis of the tube. As the fuel element moves in the direction of coolant flow, the tube presses the convex spring flat. The flattening spring, in turn, drives the locking bars into engagement with matting latches on the adjacent support grid to prevent further movement of the fuel element.

33027 Beschreibung der gegenwaertigen Praxis zu den Sicherheitskriterien fuer Kernkraftwerke. Sicherheitskriterium 8.2. Auslegungsgrundlagen des Sicherheitseinschlusses - Bestimmung von Auslegungsdruck und Auslegungstemperatur des Volldrucksicherheitsbehaelters (DWR). (Description of the present practice with regard to the safety criteria for nuclear power plants. Safety criterion 8.2. Design principles for the containment - stipulating design pressure and design temperature of the full-pressure safety containment (PWR)). Koeln, Germany, F.R.; GRS (1977). 19p.

The 'Description of the present practice with regard to the safety criteria for nuclear power plants' is to be seen as a source of information and a collection of material for safety evaluation work and elaboration of rules (KTA). It is based on relevant rules and on the know-how of the authors. Supplements and statements of the ZVEI and the VGB concerning containment design against accidents and incidents are included and set side by side.

POWER REACTORS, NON-BREEDING, GRAPHITE MODERATED

REFER ALSO TO CITATION(S) 33100, 33140

33028 (EPRI-NP—697) **Comprehensive study of the operating and testing experience during the startup and initial operation at the Fort St. Vrain HTGR. Phase 1. Preoperational testing.** Van Howe, K.R.; Raudenbush, M.H. (Stoller (S.M.) Corp., Boulder, Colo. (USA)). Feb 1978. 255p. Dep. NTIS, PC A12/MF A01.

The Phase I report documents the important experiences gained at the Fort St. Vrain HTGR plant during the performance of the preoperational tests. Also documented are general experiences at this plant which occurred during the time period of the preoperational testing to the commencement of the rise-to-power tests in April of 1975. This Phase I report also contains summary descriptions of the various Fort St. Vrain plant systems for use in intepreting the discussions contained in all three phase reports.

33029 (EPRI-NP—698) **Comprehensive study of the operating and testing experience during the startup and initial operation at the Fort St. Vrain HTGR. Phase 2. Core loading, physics, and low power testing.** Van Howe, K.R.; Raudenbush, M.H. (Stoller (S.M.) Corp., Boulder, Colo. (USA)). Feb 1978. 136p. Dep. NTIS, PC A07/MF A01.

The Phase II Report documents the important experiences gained at the Fort St. Vrain HTGR plant resulting from the formal core loading, physics and low power testing program (December, 1973 through November, 1974). This Phase II report covers the experiences at Fort St. Vrain during the performance of the low power startup tests associated with: initial loading of fuel and reflector elements; core reactivity, reactivity coefficient, and control rod worth measurements; nuclear flux distribution measurements; control rod drive and helium flow orifice valve performance; fuel handling equipment performance; helium purification system performance; and, helium circulator performance.

33030 (JAERI-M—6908) **Temperature analysis of coated-fuel-particle capsules irradiated in JRR-2.** Hayashi, T.; Miyasaka, Y.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1977. 16p. (In Japanese). Dep. NTIS (US Sales Only), PC A02/MF A01.

Intended for irradiation of coated fuel particles, two capsules without a temperature control system were irradiated in an irradiation hole 6C of JRR-2. Radial temperature distributions in the capsules were examined by means of burn-up determination and flux-monitoring wire dosimetry after irradiation. In calculation, a simple model of the spherical coated fuel particle was used. The results were in good agreement with those observed. Effective thermal conductivity of the packed bed was also estimated.

33031 Reactor core lateral restraint assembly. Brown, S.J.; Gorholt, W. (to General Atomic Co.). US Patent 4,073,685. 14 Feb 1978. Filed date 20 Feb 1976. 8p.

A spring pack for supporting a sprung mass relative to an unsprung mass includes a relatively low-rate spring unit and a relatively high-rate spring unit interconnected with each other and arranged between the sprung and unsprung masses, the relatively low-rate spring unit tending to respond to initial limited movement between the sprung and unsprung masses, a mechanical stop limiting the spring response of the relatively low-rate spring unit with relative movement beyond that limit tending to be absorbed by the relatively high-rate spring unit. A plurality of the spring packs are employed in a lateral restraint assembly for laterally supporting a reactor core relative to a vessel within a nuclear reactor, the relatively low-rate spring units absorbing initial multi-axial movement between the core and vessel with excessive movement of the core being absorbed by the relatively high-rate spring units.

33032 Method of making nuclear fuel elements. Mysels, K.J. (to General Atomic Co.). US Patent 4,073,834. 14 Feb 1978. Filed date 5 Mar 1975. 8p.

A nuclear fuel element is fabricated from a porous graphite block containing a plurality of open coolant passageways and a plurality of fuel chambers uniformly located therebetween. The fuel chambers are filled with nuclear fuel material and closed. The entire porous block is then impregnated with a liquid carbonizable impregnant which penetrates through the septa and into each of the fuel chambers, wherein it is cured and then carbonized in situ. The resulting carbon residue integrally binds the nuclear fuel material to the fuel chamber walls of the porous graphite block and provide excellent heat transfer from the fuel to the walls of the open passageways from which the heat is extracted by the coolant.

33033 High temperature reactor needs special monitoring and control. Dalry, R.H.; Long, H.A.; Franklin, R.N. (General Atomic Co., San Diego, Calif. (USA)). *Nucl. Eng. Int.;* **22**: No. 236, 50-52(Oct 1977).

The high temperature gas-cooled reactor core of nearly solid graphite plus its prestressed concrete reactor vessel call for a set of detectors and instrumentation to measure certain vital parameters and control the reactor's operation which varies markedly from water moderated systems. Brief descriptions are given of structural measurements of loads, strains, and temperatures, core coolant moisture level, helium circulator generated flow and shaft displacement. A data acquisition, processing, and display system which is integrated with the plant instrumentation is described.

33034 Measurement techniques for AGR circulators in a full-density rig. Watson, I.; Wilson, R.R. (Howden (James) and Co. Ltd., Glasgow (UK)). pp 65-79 of Operation of instruments in adverse environments, 1976. Knight, J. (ed.). Bristol; Institute of Physics (1977).

From Conference on the operation of instruments in adverse environments; London, UK (4 Oct 1976).

See CONF-7610120—.

Safety and reliability are the most important factors of a nuclear power plant. This applies in particular to the circulators used to drive the high-density CO_2 around the reactor core and boiler circuits. Under operating conditions, very high sound-pressure levels are generated which could excite components and cause possible fatigue failures. Failures of this type were experienced on the original axial blowers for the Hinkley 'A' Magnox reactor and, following this, a stringent test plan was specified for the AGR circulators. The present paper describes some of the techniques used to measure strain, sound and vibration on circulators in a full-density rig. This rig reproduces the actual reactor working conditions of 300°C and 4.1 MN m^{-2} with gas velocities up to 120 m s^{-1}. Under these conditions sound-pressure levels of up to 172 dB are generated. This programme of circulator testing has continued for the past 10 years. During this period many obstacles and difficulties were encountered. Some of these problems, together with the solutions found, are discussed.

33035 Displacement measurements at high temperatures with capacitive transducers. Turner, H.J.; Nye, A.E.T. (Central Electricity Research Labs., Leatherhead (UK)). pp 117-134 of Operation of instruments in adverse environments, 1976. Knight, J. (ed.). Bristol; Institute of Physics (1977).

From Conference on the operation of instruments in adverse environments; London, UK (4 Oct 1976).

See CONF-7610120—.

Measurements have been made on a generating plant including rotary-hood air heaters and a nuclear boiler. Although the air heaters were not an ideal environment due to the presence of dust and water vapour, capacitive transducers were successfully used. In one experiment, coplanar-electrode transducers were mounted on the rotary hood in the hot air stream, necessitating the use of specially screened slip rings. In another, they were mounted on the stator and were subject to alternate flows of hot flue gas and cool air. The nuclear boiler had a more suitable atmosphere, namely CO_2 at 280°C and 2500 kN m^{-2}, but long mineral-insulated cables were need to bring the signals out of the pressure vessel. Coplanar transducers similar to those for the air heaters were used to one measurement, but parallel plates with a moving inter-electrode screen were used at a position where more range was required. Another application was on an oxidation test rig designed to monitor the rate of oxidation of stainless steels in different atmospheres. The test piece is a thin-walled tube of about 20 mm diameter which is allowed to oxidize externally while the bore is kept free from corrosion by an atmosphere of inert gas. The different mechanical properties of the oxide set up a hoop stress causing a change in internal diameter of the tube of up to 100 μm. The capacitance variation between the inner wall and an insulated concentric electrode is measured. The temperature range required is 600°C to 1000°C and ionization of the gas gives problems from the high shunt conductance. Methods of overcoming these have been successful to to 800°C.

POWER REACTORS, NON-BREEDING, OTHERWISE MODERATED OR UNMODERATED

33036 (PNCT—831-75-02, pp 111-121) **Application of acoustic emission to the testing pressure tubing materials.** Hayashi, K.; Miura, M.; Tsunoda, N.; Nagaki, H.; Igarashi, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1975.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jan—Jun 1975.

Acoustic emission is one of the promising techniques for the detection of embrittlement. The Zr-2.5 Nb alloy used as pressure tubing material shows slightly low stress intensity factor when it absorbs hydrogen. In this paper, the relationship between acoustic emission count N and stress intensity factor K in the tensile test of edge-notched specimens is described. The K value is proportional to the square root of crack opening displacement phi in the elastic region. The double-notched specimens were cut from pressure tubes, and the single-notched specimens were cut from extruded bars. The crack opening displacement was measured with a clip gauge recommended by ASTM STP 410 Appendix, and the acoustic emission was measured with a Nortec AEMS-4 system and PZT-5 type sensors. The sensors were bonded on the surfaces of the specimens with epoxy adhesive or rubber contact. A peak of the acoustic emission count rate was observed at the yield point of each specimen similarly to many other metals. The N values and the size of plastic zone showed the theoretical relationship following 4th power law, on the other hand, the size of plastic zone depended linearly on the K values in elastic region. The slope and the intersection point of the regression curves for the total N count vs the square root of phi corresponding to the elastic field of stress-strain curves showed almost same values for the specimens of same shape. The influence of the bonding methods was not observed.

POWER REACTORS, BREEDING

REFER ALSO TO CITATION(S) 33124, 33131, 33408, 33583

33037 (BR-E—180(Vol.1)) **PLBR Phase II: (follow-on) reports.** (Burns and Roe, Inc., Oradell, N.J. (USA)). 30 Sep 1977. Contract EY-76-C-03-1145. 408p. .

Included are sections dealing with PLBR component seismic response characteristics and the response of the reactor cavity and primary heat transport system to the consequences of sodium pipe breaks. (DG)

33038 (BR-E—180(Vol.2)) **PLBR Phase II: (follow on) reports. Volume II.** Byoun, T.; Celnik, J.; Babel, P.J. (Burns and Roe, Inc., Oradell, N.J. (USA)). 30 Sep 1977. Contract EY-76-C-03-1145. 204p. .

The following PLBR design projects are described: (1) radiation shielding analysis for the reactor cooling system, (2) primary heat transport system cell layout and model, (3) steam cycle design basis, and (4) reactor support ledge and pipe penetration cooling. (DG)

33039 (CEGB-RD/B/N—3982) **Measurements of temperature fluctuations in the mixing of hot and cold air jets.** Sumner, V.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1977. 41p. Dep. NTIS (US Sales Only), PC A03/MF A01.

In order to assess the effect of the mixing of 'hot' and 'cold' jets of sodium on structures in the above-core region of the fast reactor, temperature fluctuations have been measured in an experiment consisting of a heated jet of air surrounded by six unheated jets. Temperature spectra obtained from the experiment showed no strong peaks or bands. In considering the effect of thermal cycling of the above-core structures, it is the higher strain values at low frequencies which will be more limiting than the smaller values at high frequencies, due to the nature of strain-lifetime curves. Thus the spectra have been summarised using a low-frequency level and a cut-off frequency at which this level has fallen by an order of magnitude. Attenuation of temperature fluctuations due to the high thermal conductivity of sodium or by boundary layer effects has been considered; however, in the low-frequency, high-energy region of the spectra, little attenuation can be expected.

33040 (CONF-770611—31) **Sensitivity of the power distribution in large heterogeneous LMFBR designs.** Tzanos, C.P.; Barthold, W.P. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

In heterogeneous LMFBR designs consisting of consecutive core and blanket zones, the power distribution is very sensitive to enrichment distribution changes in the core zones. The purpose of the paper is to analyze this sensitivity in heterogeneous LMFBR designs of different degrees of coupling among the core zones.

33041 (CONF-770611—34) **Neutron and gamma transport effects by heterogeneous core designs.** Lam, S.K. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

The use of diffusion theory for the prediction of power production near a reactor core-blanket interface and the assumption that gammas are absorbed in situ can lead to substantial errors. This is primarily due to the breakdown of Fick's law for neutron diffusion near the core-blanket boundary, and the gamma leakage from the core into the blanket. These considerations are more pronounced in a situation where a large number of internal blanket assemblies are present, such as in the large heterogeneous core designs. The power distribution is studied for both fission and gamma heating in a large heterogeneous LMFBR with 3 core zones separated by 2 internal blanket zones. Comparisons are made between diffusion and transport theory for neutronics calculations, and between in-situ absorption and rigorous transport theory calculation for gamma heating.

33042 (CONF-770611—35) **Potential and limitation of the heterogeneous reactor concept.** Barthold, W.P.; Beitel, J.; Khan, E.; Tzanos, C. (Argonne National Lab., Ill. (USA)). 1977. Contract W-7405-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

Characteristics of LMFBR type reactors with heterogeneous cores are described. Reactor kinetic and safety aspects of heterogeneous and homogeneous cores are compared.

33043 (CONF-770611—36) **Systematic approach for constructing low sodium void heterogeneous cores.** Tzanos, C.P.; Barthold, W.P. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

In unprotected loss-of-flow transients in large LMFBRs sodium voiding may result in high ramp rates of positive reactivity addition leading to rates of energy release that may exceed the design limits of the containment. Therefore, there is an incentive in designing reactors of low sodium void reactivity to reduce the positive reactivity ramp rates arising from sodium voiding. A systematic way of constructing heterogeneous configurations that have a near zero value of sodium void reactivity is presented.

33044 (CONF-770611—37) **Pin diameter optimization in 1200 MWe heterogeneous vs. homogeneous LMFBRs.** Orechwa, Y.; Turski, R.B.; King, M.J. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 6p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

LMFBRs with internal blankets (heterogeneous reactors) are known for reducing the sodium void reactivity and increasing the breeding ratio. As for homogeneous reactors, the optimization of the fuel pin diameter for heterogeneous reactors is of great interest. The optimum pin diameter is obtained by changing the fuel pin diameter until the homogenized fuel volume fraction is the same as the optimum fuel volume fraction of the homogeneous core. The optimization of the fuel pin diameter with respect to doubling time for a loosely coupled 1200 MWe oxide heterogeneous reactor is described. The results are compared with those of a homogeneous reactor.

33045 (CONF-770611—38) **Flow orificing of large LMFBR cores with interassembly heat transfer.** Khan, E.U.; Barthold, W.P. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-48. 7p. Dep. NTIS, PC A02/MF A01.

From American Nuclear Society annual meeting; New York, NY, USA (12 Jun 1977).

Core flow orificing is important because fuel lifetime (or burnup) is strongly dependent upon the peak cladding temperature. The peak cladding temperature in different assemblies can be made nearly equal by properly allocating the flow to each assembly through flow orificing. In the method described each orifice zone has the same peak cladding temperature at some time in life. This method is especially important for large heterogeneous LMFBR (parfait) cores where interassembly heat transfer effects become more important than for the corresponding homogeneous LMFBR. The method was applied to orifice the flow in both homogeneous and heterogeneous cores.

33046 (CONF-770822—8) **PHENIX plant: three years of operation.** (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre de Marcoule, 30 - Bagnols-sur-Ceze (France); Electricite de France, 30 - Bagnols-sur-Ceze. Centre de Marcoule). 1977. 14p. NTIS, MF A01.

From American Nuclear Society meeting; Chattanooga, TN, USA (8 Aug 1977).

Portions of document are illegible.

Information is presented concerning the operation and maintenance of the Phenix Reactor.

33047 (COO—2426-133) **Performance potential of (Th,U) carbide and (Th,U) nitride fuel in 1200 MWe LMFBR's.** Caspersson, S.A.; Kulwich, M.R. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Apr 1978. Contract EY-76-C-02-2426-001. 10p. Dep. NTIS, PC A02/MF A01.

An evaluation of the performance potential of thorium-uranium carbide and nitride fuel in 1200 MW(e) homogeneous and heterogeneous LMFBR's has been completed. Comparisons were done with 9.40 mm outer diameter, 0.38 mm cladding fuel pins at a selected peak (3 σ) linear power of 98.4 kW/m for all cores. Breeding ratios for the homogeneous (Th,U)C and (Th,U)N cores are 1.12 and 1.16, respectively. In the heterogeneous cores the breeding ratios are 0.08 to 0.09 greater. A comparative breeding ratio of 1.48 results for a sodium-bonded (U,Pu)C homogeneous LMFBR with similar design criteria. Compound inventory doubling times for the homogeneous and heterogeneous (Th,U)C cores are 82 and 53 years, respectively. Additional performance parameters have also been compared, including sodium void worths, specific inventories, fissile material gains, and equilibrium cycle reactivity losses.

33048 (GEFR—13825-20-22) **Instrumentation development twenty-second quarterly report, October 1976—June 1977.** Imhoff, D.H.; Craig, C.N. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Jul 1977. Contract EY-76-C-03-0893-009. 14p. .

The report summarizes progress in the development of instrumentation for surveillance of the core and in-vessel components of liquid metal cooled fast breeder reactors. Current development efforts focus on high temperature neutron detectors and advanced signal transmission methods.

33049 (GEFR—14031-10) **Core restraint engineering. Tenth quarterly report, November—December 1976 and January 1977.** (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Feb 1977. Contract EY-76-C-03-0893-023. 17p. .

The design guidelines and the corresponding technology required to design LMFBR core restraint systems and to support applicable licensing processes are discussed. Progress is described for subtasks related to refueling force evaluation and test, instrumented simulated fuel assemblies, core restraint transient analysis, in-reactor monitoring, advanced core restraint studies, and seismic evaluation.

33050 (JAERI-M—6795) **Effects of core design parameters on performance and economy of a gas-cooled fast breeder reactor.** Shimizu, T.; Yoshida, H. (Japan Atomic Energy Research Inst., Tokyo). Nov 1976. 30p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

C respectively. Studies have been made of the effects of three core design parameters, i.e. fuel-pellet diameter, volume ratio of coolant to fuel pins and core height, upon nuclear and thermohydraulic characteristics and fuel cycle cost of a 1000 MWe pin-type helium-cooled fast breeder reactor. Reactor models with combinations of the three parameters were obtained by single-channel thermohydraulic and two-dimensional burnup calculations assuming maximum fuel and cladding temperatures in normal operation to be 2200°C and 700°C respectively. In the ranges of fuel-pellet diameter 6-7 mm, coolant-to-fuel pin volume ratio 0.8 - 1.2 and core height 100 - 140 cm, the followings were revealed: (1) critical mass is 3200 Kg - 4800 Kg, (2) system doubling time is 10 years - 14 years, (3) thermohydraulic characteristics are good because of the low linear rating, (4) fuel cycle cost depends largely on the fuel fabrication cost, which involves much uncertainty however, in treatment of such as surface roughness, vent and fuel-pin diameter.

33051 (KFK—2442) **Fast breeder cladding tubes provided with helical fins. Development and testing.** Baumgaertner, E.; Hoffmann, H.; Miller, H.; Kathol, W.; Muehling, G.; Jacobi, O.; Bojarski, E.; Freund, D.; Reiser, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Schneller Brueter). Apr 1977. 60p. (In German). Dep. NTIS (US Sales Only), PC A05/MF A01.

Development of fast breeder tubes with helical fins started around 1966. The development was initiated mainly by the search for a more favorable alternative to the conventional spacers such as grids and spiral wires. First of all the possibility was investigated of fabricating them on an industrial scale. The first thermohydraulic and fluiddynamic tests were made in parallel by AEG, GfK and Interatom. Besides the possibility of industrial fabrication the problems of non-destructive testing for geometry and material defects had to be treated with priority. In this report the different stages of development are shown and, finally, two rather large projects are described. These projects are the study ready for the licensing procedure concerning the irradiation of finned tube oxide fuel elements in KNK II and the already completed 19-rod fuel element bundle irradiation experiment Mol 7D of GfK performed in the 500 kW sodium loop of the Belgian BR2 reactor. In this BR2 experiment the maximum target burnup of 85,000 MWd/t of oxide was attained without trouble.

33052 (LA—7161-MS) **Los Alamos Failure Model (LAFM): a code for the prediction of LMFBR fuel pin failure.** Mast, P.K. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1978. Contract W-7405-ENG-36. 47p. Dep. NTIS, PC A03/MF A01.

A new fuel pin failure model (the Los Alamos Failure Model) has been developed, a preliminary version of which is reported in this document. The model treats pin failure due to fuel-cladding differential thermal expansion, fission-gas pressurization, and cladding thermal stress. Radial fuel cracking and crack closure, as well as the presence of an initial circumferential fuel crack, are accounted for. The elastic-plastic stress-strain behavior of the cladding is calculated with a single node representation of the cladding using the Tresca Yield criterion. This results in a very fast running computer code with small storage requirements.

33053 (PNC-N—251-76-12(Vol.1), pp 187-229) **Simple and consistent equation of state for sodium in the single phase and two phase regions.** Breton, J.P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

An equation of state valid over an extended temperature and density range has been derived. Then, the following properties have

been deduced : coefficient of thermal expansion, isothermal coefficient of bulk compressibility, thermal pressure coefficient, heat capacity at constant pressure, at constant volume, along the saturation curve for liquid, for vapor, heat of vaporization, speed of sound, and finally the Mollier diagram and the entropy diagram. All the obtained properties are thermodynamically consistent and satisfy the basic relations of thermodynamics for both single phase and two-phase regions. Experimental results were always used when available.

33054 (PNC-N—952-76-04) **Operation manual for sodium-measuring equipment test loop.** Ooyama, N.; Nakamoto, K.; Sekiguchi, N.; Nakasuti, T.; Atsumo, H. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Jan 1976. 190p. (In Japanese). Dep. NTIS (US Sales Only), PC A10/MF A01.

This operation manual contains the materials and references required to operate and maintain the sodium-measuring equipment test loop that was built for the test in sodium of in-core monitoring instrumentation for the fast breeder prototype reactor "Monju". The test loop consists of sodium equipment and piping installation, gas and vacuum equipment and piping installation, preheat and heat insulation facilities, instrumentation and control equipments, power supply unit, rack and stand installation and others. It uses liquid metal sodium of approximately 2900 kg as the fluid and high purity argon gas as the cover gas. Maximum sodium temperature is specified at 600 deg C, maximum sodium flow is approximately 1000 l/min each in main circulation and auxiliary systems, and maximum working pressure is 5 kg/cm^2 G (normally 2 kg/cm^2 G). The procedures of start-up, operation and shut down are described, and the measures in abnormal and emergency conditions, maintenance and checking-up, electrical instrumentation equipments, and sodium, gas and vacuum systems are explained in detail. The last two sections are included for the reference because they are necessary for operation and maintenance, but are not used very often.

33055 **Method for removing fission products from a nuclear reactor coolant.** Colburn, R.P. (to Westinghouse Electric Corp.). US Patent 4,075,060. 21 Feb 1978. Filed date 31 Jul 1974. 6p.

A method is described for removing cesium 137, iodine 131, and tritium from a liquid sodium reactor coolant. Hydrogen is introduced into the liquid sodium causing sodium hydride to precipitate in a cold trap. The cesium, iodine, and tritium isotopes are removed from the liquid sodium by coprecipitating as impurities in the sodium hydride.

33056 **Nuclear reactor apparatus.** Wade, E.E. (to Westinghouse Electric Corp.). US Patent 4,071,402. 31 Jan 1978. Filed date 9 Aug 1976. 6p.

A lifting, rotating and sealing apparatus for nuclear reactors utilizing rotating plugs above the nuclear reactor core is described. This apparatus permits rotation of the plugs to provide under the plug refueling of a nuclear core. It also provides a means by which positive top core holddown can be utilized. Both of these operations are accomplished by means of the apparatus lifting the top core holddown structure off the nuclear core while stationary, and maintaining this structure in its elevated position during plug rotation. During both of these operations, the interface between the rotating member and its supporting member is sealingly maintained.

33057 **Fast reactor instrumentation development is aimed at a commercial plant.** Hughes, G.; Hayes, D.J.; Hobdell, M.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). *Nucl. Eng. Int.;* **22**: No. 263, 45-50(Oct 1977).

Problems and present work relating to the provision of suitable instrumentation for commercial fast reactors are reviewed. The areas involved are: safety instrumentation, which includes development for improving the sensitivity and speed of response of sensors for measurement of temperature, flow, and pressure, and detection for boilers and for sodium systems; meters for monitoring impurities in sodium and in cover gas regions; and finally monitoring and inspection of reactor components.

33058 (ORNL-tr—4577) **Reduction in fragment activity and the power of residual heat liberation in liquid salt reactors with a circulating fuel.** Blinkin, V.L.; Gel'man, E.B.; Novikov, V.M. Translated by S.D. Blalock, Jr. from *At. Energ. (USSR);* **43**: No. 2, 131-132(Aug 1977). 4p. Dep. NTIS, PC A02/MF A01.

In recent years, the question of the expediency of using molten salt breeder reactors with a circulating fuel has been extensively discussed. Such reactors utilize a uranium-thorium fuel cycle and $^{233}UF_4$ as well as the raw material for breeding ThF_4 within molten lithium and beryllium fluorides. The molten fuel salt circulates through the reaction zone, simultaneously fulfilling the function of coolant. The expanded production of fuel in the thermal uranium-thorium reactor is only possible with constant purification of the circulating fuel from fission products. The suggested and partially developed methods in principle make it possible to separate practically all fission products from the fuel salt. The set-up of such a system will make it possible not only to eliminate reactor poisoning in the process of its operation, but also to reduce the radioactivity of the fuel salt and thereby to increase the safety factor of the reactor as well as its repairability. At present, calculations of fragment activity and residual heat liberation in the circulating fuel salt have been made at various rates of separating individual groups of the chemical elements which arise during the fission of ^{233}U. The rates and regimes of separating fission products have been estimated and make it possible to reduce fragment activity to a suitable level. The calculation of the radioactivity of fission products was made for 84 ramified isobar chains of fission product decay resulting from ^{233}U. The chains were described by 174 linear decay chains, taking into account the combustion of elements under the effect of thermal neutrons and the isolation of these elements from the system in extraction devices.

33059 **Nuclear crisis. A question of breeding.** Gosling, D.; Montefiore, H. (eds.). Dorchester, Dorset; Prism Press (1977). 174p.

This book contains an edited account of the submissions and the cross-examination of Expert Witnesses at the Public Hearings on the projected Commercial Fast Reactor CFR-1 which were held at the London International Press Centre on 13 and 14 December 1976. The account is in chapters dealing with different aspects of the matter: (1) statement by Mr. Benn (Secretary of State for Energy) and replies; (2) future needs and goals for society; (3) risks (technological and social); (4) feasibilities, economic and technological; (5) CFR-1 and alternative sources of energy; (6) epilogue.

33060 **Yoyuen zoshokuro. MSBR kenkyu no shinpo to kaihatsu eno tenbo. (Molten salt breeder reactor. MSBR research and future development).** Tokyo, Japan; Atomic Energy Society of Japan (1977). 308p.

MSBR Study Group formed in October 1974 has studied molten salt breeder reactor and its various aspects. Usage of a molten salt fuel, extremely interesting as reactor chemistry, is a great feature to MSBR; there is no need for separate fuel making, reprocessing, waste storage facilities. The group studied the following, and these results are presented: molten salt technology, molten salt fuel chemistry and reprocessing, reactor characteristics, economy, reactor structural materials, etc.

REGULATION AND LICENSING

33061 (NTISUB/C/142—010) **Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, D.C. (USA)). Oct 1977. 194p. NTIS $4.75.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LPB), and the Administrative Law Judge (ALJ).

33062 **Wyhl Urteil. (Wyhl decision).** Freiburg, Germany, F.R.; Dreisam-Verl. (1977). 136p.

A transcript is presented of the decision of the administrative court at Freiburg, with which the first partial licence for the construction of the Kernkraftwerk Sued Block I was again cancelled.

REACTOR DOCKETS

33063 (DOCKET-50325—640) **Brunswick Steam Electric Plant, Units 1 and 2. Annual operating report No. 3.** (Carolina Power and Light Co., Raleigh, N.C. (USA)). 31 Dec 1977. vp. (DOCKET-50324—1251).

After a month-by-month summary of operations and maintenance activities, data are presented concerning modifications, procedure changes, and man-rem radiation doses. Appendices include information on the main generator outage, leak rate testing, refueling outage, recirculation pump modifications, and instrument drift. (FS)

33064 (DOCKET-STN-50592—1) **Palo Verde Generating Station, Units 4 and 5. License application, general information.** (Arizona Public Service Co., Phoenix (USA)). 1 Mar 1978. vp. (DOCKET-STN-50593—1).

A license application for two more Palo Verde reactors, Units 4 and 5, is presented. The two PWR reactors have a nominal net generating power each of 1,270 MW(e). Containments are steel-lined prestressed cylindrical structures with hemispherical domes. The reactors are replicas of Palo Verde 1, 2 and 3 (see DOCKETS 50528, 50529 and 50530) using the standard Combustion Engineering System 80 (see DOCKET-STN-50470). (FS)

ECONOMICS

33065 **Conventional view of the energy problem.** Brookes, L.G. (UKAEA). pp 2.1-2.11 of Supplementary volume to energy in the 80s. Rugby; Institution of Chemical Engineers (1977).

From 186. event of the European Federation of Chemical Engineering; Middlebrough, UK (5 Apr 1977).

See CONF-770471—.

It is shown that sharply increased oil prices have harmed GNP performance and reduced the rate of substitution of nuclear for fossil energy. The interaction of energy costs and prices is discussed in some detail. The part that nuclear energy has to play in this situation is outlined. It is considered that the role of nuclear energy is bound up with the exploitation of the fast breeder reactor.

33066 Computerized planning system for nuclear-power plant evaluation. Bonczek, R.H.; Holsapple, C.W.; Whinston, A.B. (Purdue Univ., West Lafayette, IN). pp 859-865 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

Research and planning activities involve three primary activities: information access, analysis, and formulation of models. The objective of this presentation is the introduction of a research tool which supports the three aforementioned activities in the context of complex socio-technological issues. This tool consists of GPLAN (Generalized Planning System) a computerized system for information storage and query processing. Although it can accommodate data of both the qualitative (verbal) and quantitative varieties, this system is illustrated primarily with the latter which can be used with mathematical models for formal analyses. The system's outstanding features are a mechanism for treating complex data structures and a language with which data organized into such structures may be utilized. GPLAN is illustrated in relation to the issue of nuclear power plant construction. This is a topical issue and it entails interdisciplinary research and planning. The features of GPLAN are explained and portrayed as an aid to nuclear power plant evaluation.

CONSTRUCTION AND OPERATION

33067 (CEA-N—1977) **Optimization of hot water transport and distribution networks by analytical method: OPTAL program.** Barreau, A.; Caizergues, R.; Moret-Bailly, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Eau). Jun 1977. 64p. (In French). Dep. NTIS (US Sales Only), PC A04/MF A01.

This report presents optimization studies of hot water transport and distribution networks by minimizing operating cost. The analytical optimization used is Lagrange's method of undetermined multipliers. The optimum diameter of each pipe is calculated for minimum network operating cost. The characteristics of the computer program used for calculations, OPTAL, are given. An example is calculated and described: 52 branches and 27 customers. Results are discussed.

FUEL CYCLE

REFER ALSO TO CITATION(S) 33047

33068 (IAE—2646) **Mathematical model on the basis of material balances for nuclear power development.** Ponomarev-Stepnoi, N.N.; Glushkov, E.S.; Grebennik, V.N.; Demin, V.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 12p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A sufficiently general mathematical model for the development of nuclear power has been developed which includes elements playing a decisive role in analyzing alternative ways in the development of nuclear power. To illustrate the procedure developed calculations have been made for several alternatives of a possible development of nuclear power over a period of thirty years. The calculated curves given show that it is possible to substantially raise the level of power in nuclear power without affecting the consumption of fissile material. A comparison is made between an alternative of developing nuclear power using only water-cooled thermal reactors and an alternative envisaging the use of secondary fissile materials for developing helium-cooled breeder reactors with a short doubling time and helium-cooled high-temperature thermal reactors as well as water-cooled thermal reactors.

PROCESS HEAT REACTORS

REFER ALSO TO CITATION(S) 32580

NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 32999

THEORY AND CALCULATION

33069 (JAERI—1248) **Fission Product Fast Reactor Constants System of JNDC.** Kikuchi, Y.; Hasegawa, A.; Nishimura, H.; Tasaka, K. (Japan Atomic Energy Research Inst., Tokyo). Nov 1976. 98p. Dep. NTIS (US Sales Only), PC A06/MF A01.

The Fission Product Fast Reactor Constants System of JNDC has been developed for providing the FP group constants set rather automatically from the Japanese Evaluated Nuclear Data Library (JENDL). In the present version, the evaluation by JNDC was adopted for the 28 important nuclides and the evaluation by Cook was supplementally used for the other nuclides to obtain the lumped group constants. The burn-up time dependence of the lumped constants were examined. The change of capture cross sections are about 5% between 60 days and 720 days of burn-up for any type of fast reactors. The 28 important nuclides take more than 80% of total capture by fission products and cover 40% of elastic scattering and 60% of inelastic scattering. The JNDC FP lumped constants were compared with those based on Cook's evaluation and on the ENDF/B-4. The discrepancies among the three are 15% for capture and 10% for both of elastic and inelastic scattering. A benchmark test was performed using the integral measurements made in RCN, Petten, the Netherlands, in order to check the reliability of the JNDC FP group constants. The JNDC constants give better agreements than the Cook and ENDF/B-4 constants with the experiments both for FP mixtures and for separated isotopes.

33070 (JAERI-M—6853) **Present status on numerical algorithms and benchmark tests for point kinetics and quasi-static approximate kinetics. Benchmark tests on the space-dependent neutron kinetics code.2.** Ise, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1976. 80p. (In Japanese). Dep. NTIS (US Sales Only), PC A05/MF A01.

Review studies have been made on algorithms of numerical analysis and benchmark tests on point kinetics and quasistatic approximate kinetics computer codes to perform efficiently benchmark tests on space-dependent neutron kinetics codes. Point kinetics methods have now been improved since they can be directly applied to the factorization procedures. Methods based on Pade rational function give numerically stable solutions and methods on matrix-splitting are interested in the fact that they are applicable to the direct integration methods. An improved quasistatic (IQ) approximation is the best and the most practical method; it is numerically shown that the IQ method has a high stability and precision and the computation time which is about one tenth of that of the direct method. IQ method is applicable to thermal reactors as well as fast reactors and especially fitted for fast reactors to which many time steps are necessary. Two-dimensional diffusion kinetics codes are most practicable though there exist also three-dimensional diffusion kinetics code as well as two-dimensional transport kinetics code. On developing a space-dependent kinetics code, in any case, it is desirable to improve the method so as to have a high computing speed for solving static diffusion and transport equations.

33071 (JEN—369) **Xe-135 and Sm-149 isotopic evolution analysis. Xesamo code.** Caro, R.; Gallego, J.; Martinez Fanegas, R. (Junta de Energia Nuclear, Madrid (Spain)). 1977. 52p. (In Spanish). Dep. NTIS (US Sales Only), PC A04/MF A01.

The time evolution analysis of the nucleides concentration Xe-135 and Sm-149 as a function of the neutron flux is carried out. The neutron flux may be any function of time. It is analyzed as well the reactivity changes associated with the xenon and samarium concentration variations.

33072 (KFKI—76-64) **Measurement of the local and global effects of bubbles in a water moderated reactor.** Fuge, R.; Kaetzmer, D.; Valko, L.; Czibok, T.; Vasilescu, M. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Oct 1976. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

In the paper a set of experiments is described in which the effect of gas bubbles on neutron flux was measured and analysed directly in the time domain. A zero power facility containing part of a typical PWR core was used. To simulate the effect of steam in the moderator air bubbles were introduced from under the core. Two ionization chambers were used as detectors. One set of measurements were performed inside the core, other measurements were made at the core-reflector interface. It was found that in the in-core measurements the detector at different distances measured nearly the same global effects, while the local signal decreased in magnitude with a spatial relaxation length of 2.12 cm. Measurements at the

core-reflector interface indicated a very different behaviour from the expected one.

33073 (NRCN—419) **Methods for thermal reactor lattice calculations.** Schneider, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Technion-Israel Inst. of Tech., Haifa). Dec 1976. 150p. (In Hebrew). Dep. NTIS (US Sales Only), PC A07/MF A01.

Thesis.

The American code HAMMER and the British code WIMS, for the analysis of thermal reactor lattices, have been investigated. The primary objective of this investigation was to identify the causes for the discrepancies that exist between the calculated and the experimentally determined reactivity of clean critical experiments. Three phases have been undertaken in the research: (a) Detailed comparison between the group cross-sections used by the codes; (b) Definition of the various approximations incorporated into the codes; (c) Comparison between the values of a variety of reaction rates calculated by the two codes. It was concluded that the main cause of discrepancy between calculations and experiments is due to data inaccuracies, while approximations introduced in solving the transport equation are of smaller importance.

33074 **Transient version of URANUS computer code.** Lassmann, K. (Technische Hochschule Darmstadt (Germany, F.R.). Fachgebiet Reaktortechnik). *Atomwirtsch., Atomtech.;* **22**: No. 10, 521-524(Oct 1977). (In German).

The treatment of the unsteady equation of thermal conductivity may be considered as solved within the frame of the computer code URANUS. As, in principle, also each material law may be treated, the theoretical requirements for the analysis of fast-developing accidents are fulfilled. Thus the URANUS system may be used for treating preliminary transient experimental results and subsequently for the accompanying planning and evaluation of experiments.

33075 **Transferring concepts in nuclear technology with computer generated films.** Jones, R.B. (Sandia Labs., Albuquerque, N.Mex. (USA)); Tavel, M.A. (Vassar Coll., Poughkeepsie, N.Y. (USA)). *Ann. Nucl. Energy;* **4**: No. 6, . 353-368(1977).

From Iran conference on transfer of nuclear technology; Persepolis/Shiraz, Iran (10 - 14 Apr 1977).

The historical role of educational computer animation is discussed. The economic as well as practical needs for improved training aids in nuclear engineering are shown to be served by computer generated films. Some basic nuclear technological topics such as radioactive decay chains and reactor control which can be presented via computer animation are outlined. Examples of how the animation could be accomplished by sequential photographing of a cathode ray oscilloscope output of a computer is then described. The general advantages of such films (about 15 min in duration each) are compiled in order to show the applicability in general, engineering, and public education. A description and evaluation of one such film produced by the authors is presented. The film portrays the spatial and time dependence of neutron flux and its time constants during a self-limiting reactivity excursion in a simple representation of water moderated reactor.

33076 **Abkuerzungen aus der Kerntechnik. (Abbreviations from nuclear engineering).** Becker, K. (DIN Deutsches Inst. fuer Normung e.V., Berlin (Germany, F.R.). Normenausschuss Kerntechnik). Berlin, Germany, F.R.; Beuth (1977). 45p.

The brochure contains abbreviations of the main reactors and nuclear power plants, of accelerators and large-scale plants, of firms concerned with nuclear engineering, government and private organizations (associations, scientific-technical institutions, etc.), nuclear terms, whereby a relatively broad view is taken of 'nuclear engineering' and, e.g., radiation protection, radiological measuring techniques and nuclear law are also included.

33077 **Reactor core fuel management.** Silvennoinen, P. (Valtion Teknillinen Tutkimuskeskus, Helsinki (Finland)). Oxford; Pergamon Press (1976). 257p.

The subject is covered in chapters, entitled: concepts of reactor physics; neutron diffusion; core heat transfer; reactivity; reactor operation; variables of core management; computer code modules; alternative reactor concepts; methods of optimization; general system aspects.

COMPONENTS AND ACCESSORIES

REFER ALSO TO CITATION(S) 33399, 33409

33078 (CEA-CONF—3931) **Modeling and identification of ARMG models for stochastic processes: application to on-line computation of the power spectral density.** Zwingelstein, G.; Thabet, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). 1977. 6p. (In French). (CONF-770472—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Colloquim on the signal processing and its applications; Nice, France (26 Apr 1977).

Control algorithms for components of nuclear power plants are currently based on external diagnostic methods. Modeling and identification techniques for autoregressive moving average models (ARMA) for stochastic processes are described. The identified models provide a means of estimating the power spectral density with improved accuracy and computer time compared with the classical methods. They are particularly will suited for on-line estimation of the power spectral density. The observable stochastic process y (t) is modeled assuming that it is the output of a linear filter driven by Gaussian while noise w (t). Two identification schemes were tested to find the orders m and n of the ARMA (m,n) models and to estimate the parameters of the recursion equation relating the input and output signals. The first scheme consists in transforming the ARMA model to an autoregressive model. The parameters of this AR model are obtained using least squares estimation techniques. The second scheme consists in finding the parameters of the ARMA by nonlinear programming techniques. The power spectral density of y(t) is instantaneously deduced from these ARMA models.

33079 (CEA-R—4834) **Contribution to the resolution of algebraic differential equations. Application to electronic circuits and nuclear reactors.** Monsef, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique; Paris-11 Univ., 91 - Orsay (France)). May 1977. 447p. (In French). Dep. NTIS (US Sales Only), PC A20/MF A01.

Thesis.

This note deals with the resolution of large algebraic differential systems involved in the physical sciences, with special reference to electronics and nuclear physics. The theoretical aspect of the algorithms established and developed for this purpose is discussed in detail. A decomposition algorithm based on the graph theory is developed in detail and the regressive analysis of the error involved in the decomposition is carried out. The specific application of these algorithms on the analyses of non-linear electronic circuits and to the integration of algebraic differential equations simulating the general operation of nuclear reactors coupled to heat exchangers is discussed in detail. To conclude, it is shown that the development of efficient digital resolution techniques dealing with the elements in order is sub-optimal for large systems and calls for the revision of conventional formulation methods. Thus for a high-order physical system, the larger the number of auxiliary unknowns introduced, the easier the formulation and resolution, owing to the elimination of any form of complex matricial calculation such as those given by the state variables method.

33080 **Radiation shielding device for nuclear facilities.** Aoki, M. (to Hitachi, Ltd.). US Patent 4,071,404. 31 Jan 1978. Priority date 22 Dec 1975, Japan. 8p.

A pressure vessel of a nuclear reactor is bodily enclosed by an inner layer made of a heat insulating material and an outer layer made of a radiation shielding material, and a nozzle joined by welding to the pressure vessel and a pipe joined by welding to the nozzle projected outwardly from the pressure vessel to extend through openings formed in the two layers. A removable heat insulator detachably attached to an edge of the inner layer defining the opening is disposed in a manner to surround the nozzle. A shielding frame is secured to walls defining the opening in the outer layer, to provide a manhole through which the nozzle and the pipe extend. A plurality of radiation shielding blocks are hingedly supported by an outer end of the shielding frame which is remote from the pressure vessel, while a plurality of radiation shielding plates are hingedly supported by an inner end of the shielding frame which is near to the pressure vessel. When the nuclear reactor is in operation, the radiation shielding blocks are kept in a closed position to plug the manhole, while the radiation shielding plates are kept in an open position. If the nuclear reactor is shut down and inspection of the welds is performed, the radiation shielding blocks are opened, the heat insulator is temporarily removed from its position and some of the radiation shielding plates are closed whereby an open space between the nozzle and pipe and the shielding frame can be closed to avoid exposure of the whole-body of the inspector to radiation.

33081 (FEI—628) **Modelling of indicatrix with ellipsoidal anisotropy by the Monte Carlo method.** Usikov, D.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1975. 7p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A simple modelling method is proposed for the anisotropic scattering indicatrix of particles, which occurs in Monte-Carlo calculations for radiation interactions with matter. The degree of anisotropy can be chosen arbitrarily by means of a corresponding choice of the experiment for the scattering ellipsis. The method can be applied for deep penetration calculations in neutron and gamma-radiation shielding problems and also in calculations of radiation

propagation along construction gaps in the shielding material of reactors.

33082 (IAE—2702) **Radiation effect on thermal and electric conductivity of reactor graphite.** Platonov, P.A.; Trofimchuk, E.I.; Karpukhin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 20p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Results are presented on the measurement of the heat and electric conduction properties of the standard reactor graphite in the initial and irradiated states in the temperature interval from 20 to 600°C, pointing to a significant reduction of the heat conduction properties of the graphite exposed to irradiation. Irradiation effect grows as the temperature decreases, which is especially notable at temperatures not exceeding 250 to 300°C when heat conduction drops off scores of times. Irradiation of the graphite at about 550°C up to a dose of $3x10^{21}$ neutr/cm (E>0.18 MeV) causes the reduction of the heat conduction coefficient by a factor of 3. The dependence of heat conduction on measurement temperature varies substantially by irradiation, which points to the predominant influence of radiation defects on heat conduction properties. The most substantial effect on the graphite heat is produced by vacancies, implanted atoms and vacancy loops. Larger defects produce insignificant effect on the heat conduction properties. A temperature dependence of the Wiedemann-Franz law for the reactor graphite irradiated at 500 to 550°C is given, which permits the evaluation of the heat conduction magnitude for the irradiated graphite by its electric resistance.

33083 (JAERI-M—6801) **Identification of OWL-0 plant dynamics and its application to evaluation of the control systems.** Oguma, R.; Fujii, Y.; Akutsu, C.; Yonekawa, I. (Japan Atomic Energy Research Inst., Tokyo). Dec 1976. 37p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The statistical identification technique in linear multivariable systems has been applied to identify dynamics of the OWL-0 plant. The identified mathematical model was used to study the dynamics and evaluate the plant control. The results revealed problems in plant control, such as mutual interactions of subsystems caused by dynamics relation between the separator water level and the jetcondenser pressure and their interfering effects on the control systems.

33084 (KFK—2449) **Iodine filters in nuclear power stations.** Wilhelm, J.G. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). Apr 1977. 139p. Dep. NTIS (US Sales Only), PC A08/MF A01.

On the basis of calculated and recorded release rates of nuclear power plants, the significance of iodine releases in the invironmental impact relative to other nuclides is discussed. The release pathways for iodine in LWR-type reactors and the efficiency of various methods to lower the activity release are given. The airborne species of iodine are discussed with regard to their removal in iodine sorption filters and environmental impact. The technical status of iodine removal by means of iodine sorption filters is studied for normal operation and accident conditions in nuclear power stations on the basis of the data given in the relevant literature for the efficiency of a number of iodine sorption materials. The applicability of concepts for ventilation and containment and their influence on iodine filter systems are discussed. Design, structure, and testing of iodine sorption filters are treated in detail; recommendations for design are given, and failure sources are mentioned.

33085 (UJV—3434-M) **Effect of copper and vanadium on the radiation embrittlement and hardening of chromium-molybdenum steel for reactor pressure vessels.** Vacek, M. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jan 1976. 26p. (In Czech). Dep. NTIS (US Sales Only), PC A03/MF A01.

Six laboratory heats of chromium-molybdenum steel with 2 different vanadium content levels (0.04 wt.% and 0.27 wt%) and 3 copper content levels (0.09 wt.%, 0.15 wt.% and 0.2O wt.%) were studied. Miniature impact and tensile specimens were irradiated to a neutron fluence of $1x10^{19}$ cm^{-2} (E>1 MeV) at two irradiation temperatures: 310°C and below 100°C. The copper induced increase in radiation embrittlement was distinct only for the 0.20 wt.% copper content after irradiation at 310°C. No correlation of radiation hardening and embrittlement was found for specimens irradiated at 310°C and below 100°C. A moderate vanadium induced increase in radiation embrittlement was found after irradiation at 310°C.

33086 Instrumentation for the measurement of vibration in severe environments, such as nuclear reactors. Bierney, T.K. (Endevco UK Division, Royston, Herts (UK)). pp 103-116 of Operaton of instruments in adverse environments, 1976. Knight, J. (ed.). Bristol; Institute of Physics (1977).

From Conference on the operation of instruments in adverse environments; London, UK (4 Oct 1976).

See CONF-7610120—.

The measurement of vibration and pressure (including acoustic levels) in hostile environments such as those found in generation of nuclear power presents many special problems. Transducers may be required to operate in environments composed of a combination of high temperature, high pressure, high acoustic levels, high radiation exposure and a corrosive atmosphere. These hostile environments can present a challenge to the transducer designer in terms of materials to be used and the mounting of the transducers. The challenge extends further as the transduced signal must be transmitted to monitoring equipment outside the hostile environment. The signal conditioning of transducers used at high temperature also requires careful design to obtain useful data. For example, conventional charge amplifiers may be unusable with transducers at high temperature due to the sensing element of the transducer undergoing severe changes in its characteristics. This paper will discuss the types of vibration transducer for a nuclear reactor environment, the design of suitable piezoelectric transducers and the signal transmission and conditioning.

33087 Abschliessung der den Reaktorsicherheitsbehaelter durchdringenden Rohrleitungen im Falle einer Freisetzung von radioaktiven Stoffen innerhalb des Reaktorsicherheitsbehaelters. Entwurf. (Sealing of the containment penetrating piping in the case of released radioactivity within the containment. Draft). Berlin, Germany, F.R.; Beuth (1977). 8p. (DIN—25438).

The rule is valid for nuclear power plants with light water reactors. Requirements on the arrangement, control, closing time, tightness and testing are fixed in order to guarantee the closing of the pipelines penetrating through the containment after release of radioactive material in the room atmosphere of the containment - especially due to loss-of-coolant accidents or according to the system concept, also as a result of cladding tube damage.

33088 Kerntechnische Anlagen; Armaturen; Vorpruefunterlagen und Dokumentation. Entwurf. (Nuclear facilities; valves; preliminary test documents. Draft). Berlin, Germany, F.R.; Beuth (1977). 6p. (DIN—25418(Pt.2)).

The present draft standard applies to valves and to connecting elements between the valves and other components in nuclear power plants and research reactors. It intends to provide an aid for preliminary testing and documentation of armatures with the aim of simplifying the preliminary test procedure.

33089 Alarmanlagen, Personensuchanlagen und Fernmeldeverbindungen in und von Kernkraftwerken. T. 1. Einblockanlagen. (Alarm, public address, and telecommunication systems. Pt. 1. One-unit facilities). Koeln, Germany, F.R.; Heymanns (1977). 5p. (KTA—3901(Pt.1)).

The purpose of the standard is to stipulate type and volume of alarm, public address, and telecommunication systems within a nuclear power plant, and the connection via these systems with the outside. Requirements to be met by design, construction, operating equipment and testing of the alarm and public address systems for nuclear power plants are specified.

33090 Notstromversorgung in Kernkraftwerken. Uebergeordnete Anforderungen. Sicherheitstechnische Anforderungen. Entwurf. (Emergency power supply in nuclear power plants. Requirements on a higher level. Safety requirements. Draft). Berlin, Germany, F.R.; Beuth (1976). 26p.

Included are specifications for field of application, definitions, requirements on the emergency power supply and the mains, operation, maintenance, repair and examinations.

33091 Aeussere Bauwerksabdichtungen in kerntechnischen Anlagen. Weisungsbeschluss 8. (External sealing of constructions in nuclear facilities. Technical instructions 8). Essen, Germany, F.R.; VdTUeV (1976). 9p.

The present decision of the TUeV-Leitstelle Kerntechnik contains a compilation of sealing materials and methods. The main DIN standards, guidelines and instruction sheets, which can be consulted for expert appraisement, are also listed.

33092 Die dynamische Relaxation und ihre Anwendung auf Spannbeton-Reaktordruckbehaelter. (Dynamic relaxation method and its application on prestressed concrete reactor pressure vessels). Zerna, W. (Bochum Univ. (Germany, F.R.). Inst. fuer Konstruktiven Ingenieurbau). Berlin, Germany, F.R.; Ernst (1976). 76p.

This report is a summarizing description of the dynamic relaxation method for calculation of three-dimensional continua and its application on prestressed concrete reactor pressure vessels. The differential equations and hence finite difference equations are derived by starting from the basic equations of the general theory of elasticity. The formulation of boundary conditions is explained - also for boundaries nonparallel to coordinates. Conditions for stability and convergence of the calculation are described. A similar method for temperature field analysis is shown. It is demonstrated by examples that dynamic relaxation is an appropriate method for designing prestressed concrete pressure vessels. Thereby, consideration of concrete creep is treated in particular, including effects due to loading history, material data, and analysis. Some special problems are discussed too, i.e.: instationary states of loading and temperature,

load changes with local cracking, and interaction of concrete and steel components.

FUEL ELEMENTS

33093 (JAERI-M—6878) **Analysis of pellet center temperatures measured in HALDEN IFA-224 using program FREG-3.** Harayama, Y.; Izumi, F. (Japan Atomic Energy Research Inst., Tokyo). Jan 1977. 29p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

To verify the program FREG-3, we compared the calculations by FREG-3 with those by measurement in a HALDEN instrumented fuel assembly, IFA-224. FREG-3 generally gives higher pellet center temperatures than the measurement. The temperature distribution calculated by FREG-3 to estimate the stored energy in fuel rods results in safety side.

33094 (JAERI-M—6904) **Densification of uranium dioxide fuel pellets, (I).** Uchida, M.; Yanagisawa, K.; Ichikawa, M. (Japan Atomic Energy Research Inst., Tokyo). Feb 1977. 23p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Eight kinds of UO_2 pellets with varying density, grain size and pore size distributions were irradiated to burnups of 8,000 to 11,000 MWD/t-UO_2 in JMTR. Pre-irradiation density measurements were made by different methods, and post-irradiation ones only by an immersion method in meta-xylene. The results were compared with pre-irradiation ones. Densifications in the initially 95%TD pellet groups showed remarkable dependence upon the grain size; densification was large in pellets with small grain size. In the initially 90%TD pellet groups, densifications were much smaller. Post-irradiation pore size distributions also supported the results. No significant grain growth was observed during irradiation. On the other hand, remarkable grain growth was observed in pellets in out-pile heating, at 1700°C for 24 hrs, as well as density increase.

33095 (KFK—2477) **Analysis of the structure and the thermal behaviour of the UO_2-PuO_2-fuel in the irradiation experiment FR2 capsule test series 5a.** Jimenez, J.L.; Elbel, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe (Germany, F.R.). Projekt Schneller Brueter). Jun 1977. 21p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

In the Karlsruhe research reactor FR2 nine fuel pins were irradiated within three irradiation capsules. The pins contained UO_2-PuO_2 fuel pellets. The times of irradiation were different for the three capsules. They reached burnup values of about 6, 17, and 47 MWd/kgMe with linear rod powers of 400 to 600 W/cm and clad surface temperatures between 500 and 700°C. A detailed analysis of the fuel structure was carried out in order to determinate fuel surface temperatures. For this purpose two models were used describing the formations of the columnar-grain growth region and the equiaxed-grain growth region, respectively, as function of the irradiation time and the temperature profile in the fuel. The results of the analysis showed that the heat transfer through the contact zone became worse and consequently the fuel surface temperature rose with increasing burnup. Fuel surface temperatures calculated by means of a heat transfer model agreed very well with those determined from the fuel structures.

33096 **ZR_2NI as a getter metal and nuclear reactor fuel element employing such.** Barosi, A. (to SAES Getters SpA). US Patent 4,071,335. 31 Jan 1978. Priority date 10 Apr 1975, Italy. 6p.

Zr_2Ni sorbs both oxygen and hydrogen from water making its use advantageous as a getter metal in a nuclear reactor fuel element.

CONTROL SYSTEMS

33097 (WCAP—9218) **Results of the control rod worth program.** Henderson, W.B. (Westinghouse Nuclear Energy Systems, Pittsburgh, Pa. (USA)). Oct 1977. 17p. Electric Corp., Pittsburgh.

A control rod worth program was undertaken to improve the agreement between rod worth predictions and measurements by eliminating inadequacies in both the analytical and measurement methods. New Ag-In-Cd control rod group constants which produce satisfactory agreement (+0.745 +- 2.71% error) with critical experiments and plant data were generated by an improved calculation of transport-equivalent two-group diffusion parameters. The good agreement demonstrated between measured and predicted rod worths warrants a reduction of the uncertainty allowance for N-1 rod worth predictions from the current value of 10% to 7% at the 95/95 confidence level for Ag-In-Cd control rods.

33098 **Boron control system for a nuclear power plant.** Van der Schoot, M.R. (to Westinghouse Electric Corp.). US Patent 4,073,683. 14 Feb 1978. Filed date 22 May 1973. 8p.

Two sets of ion exchangers or other means which are capable of reversibly storing borate ions are continuously or semi-continuously utilized to provide a nuclear reactor with a supply of both a highly concentrated boric acid solution and a solution having a very low concentration of boron. The process is essentially a timed-two-cycle flow scheme. During the first cycle, fluid is sent from a high concentration storage tank via a cooler and a first set of ion exchanger to a low concentration storage tank while simultaneously sending fluid from a low concentration storage tank via a heater and a second set of ion exchanger to the high concentration storage tank. During the second cycle, the flow through the ion exchangers is reversed such that the flow from the high concentration storage tank which has been cooled is sent to the low concentration storage tank via the second set of ion exchangers, and the flow from the low concentration storage tank which has been heated is sent to the high concentration storage tank via the first set of heat exchangers. The two-cycle flow scheme is repeated continuously or as often as necessary to obtain the proper concentration in the two storage tanks.

33099 **Releasable extension shaft coupling.** Cepkauskas, M.D. (to Combustion Engineering Inc.). US Patent 4,073,684. 14 Feb 1978. Filed date 27 Sep 1976. 6p.

The control element assembly in a nuclear reactor is connected to its extension shaft by spring collet structure whose sections are locked to the extension shaft by a plunger actuated by a spring which is also a part of the buffer mechanism of the assembly.

33100 **Nuclear reactor shutdown system.** Glazar, J.M.; Hoffmann, E.H.P. (to General Atomic Co.). US Patent 4,073,681. 14 Feb 1978. Filed date 5 Mar 1975. 6p.

A shutdown system is described for a nuclear reactor wherein a gate, which allows poison to pass to the reactor core, is allowed to move to an open position upon the severing of a fuse link by electric current passed therethrough.

33101 **Reaktorschutzsystem und Ueberwachung von Sicherheitseinrichtungen. (Reactor protection system and supervision of protection equipment).** Koeln, Germany, F.R.; Heymanns (Mar 1977). 13p. (In German). (KTA—3501).

The rule contains a summary of criteria for the design, reliability requirements, and requirements to be met by the functioning of the reactor protection system. It regulates design, construction, the quality of the equipment, and installing and testing the reactor protection system and its components. The reactor protection system, as a part of the safety system of nuclear facilities comprises all equipment and devices for recording measured values, all equipment and devices concerned with signal processing, the logical part, and the level for controlling the release of protective actions, as well as this equipments' supply with electrical power and auxiliary media. Basic requirements to be met by recording equipment, change limits, electrical power supply equipment, ventilation equipment, and danger alarm systems are to be of the No. 1 category according this rule.

ENVIRONMENTAL ASPECTS

REFER ALSO TO CITATION(S) 33264, 33671, 33723, 33724, 33725

33102 **Nuclear power and the environment. The Government's response to the sixth report of the Royal Commission on Environmental Pollution (Cmnd. 6618).** London; H.M. Stationery Office (1977). 21p. (Cmnd—6820).

This White Paper deals in terms of general policy, and in detail, with the recommendations of the Royal Commission. The place for nuclear energy in the U.K. domestic power programme is to be considered, taking into account technical, economic, social, environmental and security matters. The subject is dealt with in sections entitled: energy policy; management of radioactive wastes; radiation exposure and environmental pathways; non-proliferation and security; the need for public debate.

33103 **Proliferation of nuclear technology.** Habgood, J.S. (Council on Christian Approaches to Defence and Disarmament (CCADD)). London; Council on Christian Approaches to Defence and Disarmament (1977). 15p.

An account of the problem of nuclear energy and its organization in Britain summarizes the benefits and risks and states the ethical dilemma facing society.

33104 **Numerical simulation of some environmental effects of Energy-Park Wet Plume.** Lee, J.L.; Chen, F.C. (NUS Corp., Rockville, MD). pp 31-36 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

One of the recent concepts of electrical power generation, the energy park, is receiving increasing attention as the feasible nuclear power plant sites become less and less available. Nuclear steam electric plants discharge waste heat to the cooling systems, and eventually end up in the environment. The amount of waste heat discharged is almost twice the amount of electricity generated. It is the purpose of this paper to present some preliminary numerical simulation results of the effects of conceptual energy park evaporative cooling tower effluents upon atmospheric environment, which may yield useful information for the large cooling systems design analysis.

33105 Power that corrupts. The threat of nuclear power promotion in Ireland. Blackith, R.E. Dublin; Dublin University Press Ltd. (1976). 88p.

This book sets out the case against nuclear power for Ireland, North and South. It is not a technical book; the issues involved are only partly technical, their more important content is social and moral. Because the Irish Electricity Supply Board have put American Light Water Reactors on top of their shopping list and because the French have discovered what such purchases mean in practice special emphasis is laid on recent French experience. A comprehensive list of references to literature critical of the use of nuclear power is given at the end of the book.

33106 Nuclear energy: the unforgiving technology. Knelman, F.H. Edmonton, Alberta; Hurtig Publishers (1976). 259p.

A polemic against nuclear power is delivered, with special attention to Canadian conditions.

SITING

33107 (NUREG—0180(Draft-Rev.)) **Early site reviews for nuclear power facilities: procedures and possible technical review options. Draft.** (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Feb 1978. 61p. .

The document provides guidance for utility companies, State and other governmental agencies, and others who may request or may wish to participate in an early review of site suitability issues related to a site proposed for a nuclear power or test reactor. Although the emphasis of this document is on a nuclear electric generating station, the guidance provided can be used for a test reactor or other kinds of reactors. The procedures to be followed by applicants for construction permits and by others are described and the possible significant areas of technical review are delineated.

33108 Standortbereitstellung fuer Energieanlagen. (Site provision for energy facilities). Dreyhaupt, F.J. (Haus der Technik e.V., Essen (Germany, F.R.)). Essen, Germany, F.R.; Vulkan-Verl. (1977). 93p.

After the 1973 oil crisis, another crisis is on its way, not only in the FRG but also in other EC countries, in the USA and in Japan: the site crisis. Opposition of portions of the population against nuclear energy and against coal power stations is growing. The situation becomes critical, now that drawn out administrative court procudures accompany almost every licensed power station. The solution to the site problems might be found in long-term site provision with the existing means of planning laws. Baden-Wuerttemberg, Bavaria and Northrhine-Westphalia have already taken this path, which is to provide sites for energy facilities with planning horizons up to 1990. This review which presents the site situation in the FRG and the ways to site provision, is to make, on the one hand, a contribution to the international discussion, and attempts on the other hand, to give those concerned insight into the instrumentation of planning provision.

33109 (ORNL-tr—4568) **Legal problems of the licensing procedure for nuclear facilities: site determination and safety.** Bluemel, W. 1974. Translated by J. Crabbs from pp 33-46 of Law—Technology—Economics Series, Volume 7, Carl Heymanns Publishers KG, Cologne . (CONF-741083—5). 11p. Dep. NTIS, PC A02/MF A01.

From 3. symposium on atomic energy law; Goettingen, F.R. Germany (22 Oct 1974).

A brief discussion is presented of legal, socio-economic, safety, and public relations aspects of nuclear power plant licensing and site selection. (DG)

RADIOACTIVE EFFLUENTS

REFER ALSO TO CITATION(S) 33759

33110 (LUNFD6-NFRA—3011) **In situ measurements with a mobile Ge(Li)-spectrometer around a nuclear power plant.** Finck, R.R.; Liden, K.; Persson, R.B.R. (Lund Univ. (Sweden). Radiofysiska Institutionen). Apr 1977. 9p. (CONF-770401—31). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 5. international conference on reactor shielding; Knoxville, TN, USA (18 Apr 1977).

A mobile Ge(Li)-gamma spectrometric measuring system has been used for in situ determination of the impact of a BWR power plant on the ambient radiation level. The high energy gamma-ray photons of 6.13 and 7.11 MeV from the decay of N-16 (T1/2 = 7.14 s) and 5.30 MeV from C-15 (T1/2 = 2.5 s), which are present in the generator steam, have been recorded close to the turbine hall together with a broad continuum of scattered radiation. The variation of this radiation with distance from the turbine hall and with the electric power output has been studied.

33111 Begraensning av utslaepp av radioaktiva aemnen fraan kaernkraftstationer. (Limitation of discharges of radioactive elements from nuclear power plants). Stockholm (Sweden); Statens Straalskyddsinstitut, Stockholm (1977). 16p.

The new regulations on limits for releases of radioactive material from Swedish Nuclear Power Plants are listed, as issued by the Swedish National Institute of Radiation Protection.

33112 Kabeldurchfuehrungen im Reaktorsicherheitsbehaelter von Kernkraftwerken. (Electrical cables in a reactor containment of nuclear power plants). Koeln, Germany, F.R.; Heymanns (1976). 6p. (KTA—3403).

The regulation applies to electrical cables in containments of LWRs. It deals with safety requirements concerning design, calculation, construction, assembling, and tests.

CHEMICAL AND THERMAL EFFLUENTS

REFER ALSO TO CITATION(S) 33173

RESEARCH, TEST, AND EXPERIMENTAL REACTORS

REFER ALSO TO CITATION(S) 33131

33113 (JAERI-M—6736) **Nuclear calculation of the JMTR core, (2). Revision of the neutron flux calculation method.** Ando, H.; Iida, H.; Nagaoka, Y.; Oyamada, R. (Japan Atomic Energy Research Inst., Tokyo). Oct 1976. 34p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The method of nuclear calculation for JMTR core configuration is well established. Due to advance in the calculation techniques, however, the method has been partly revised, as follows. In calculating the fast neutron group constants, space dependent spectra obtained with code ANISN are used, not the spectra calculated by B-1 approximation. And, regional, group-dependent axial bucklings (B sub(Z)sup(2)) are fed in the diffusion code. The codes employed are GGC-4 for fast neutron group constants, THERMOS-JMTR for thermal neutron group constants and CITATION for diffusion calculation. It is then considered in the diffusion code how the boundary conditions at the exterior influence the neutron flux distribution.

33114 (KFK-EXT—15/77-1) **Operation and utilization of the FR2 in 1976. Summary.** Bluemle, J. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Abt. Reaktorbetrieb und Technik). Apr 1977. 37p. (In German). Dep. NTIS (US Sales Only), PC A04/MF A01.

The heavy-water moderated FR2 research and material testing reactor was operated according to schedule in 1976 at 44 MW nominal power. The percentage of time the reactor was operating at full load, related to the scheduled operating time at full load, was about 89%. Noticeable disturbances having effects on the reactor operation did not occur within the period of reporting. The utilization by experiments continued to be good. The isotope production of 2627 irradiated capsules attained its maximum. Besides, silicium specimens (production of semi-conductors) with a total specimen length of 163 running meters were irradiated. To produce fission product moybdenum from U-235, a separate heavy-water cooled reactor insert was commissioned. At the 12 beams tube outlets, which can be reasonably used, up to 18 beam tube experiments were conducted in parallel. The number of instrumented fuel capsule test rigs slightly decreased; up to 9 rigs in total had been inserted at the same time. In addition, three rigs for pr-irradiations had been installed. Of the four large-scale loop experiments three were operated the whole year, the fourth was operated several times for one or two days each, depending on the test program. The operation of the thermionic converter and of the γ-irradiation device was according to schedule. A total of 85 pictures were taken with the neutron radiography system.

33115 (LTR—144-11) **LOFT ECC Pitot Tube and Thermocouple Rake Penetration thermal analysis.** Tolan, B.J. (Idaho National Engineering Lab., Idaho Falls (USA)). 9 Jul 1977. Contract EY-76-C-07-1570. 69p. (RE-A—77-043). Dep. NTIS, PC A04/MF A01.

A thermal analysis of the LOFT ECC Pitot Tube and Thermocouple Rake Penetration was performed using COUPLE, a two-dimensional finite element computer code. Four transients which

conservatively cover all transients the rake will be exposed to were included in this analysis in order to comply with the ASME Code Section III requirements. The transients conservatively cover hot and cold leg operation, and nuclear and nonnuclear operation. The four transients include the LOCE with ECC injection transient, the single control rod drop transient, the scram transient, and the heatup with 0 to 100% load change transient. Temperature distributions in the rake were obtained for each of the four transients and several plots of node temperatures vs. time are given.

33116 Method of making ZRH fuel element. Eggers, G.H. (to General Atomic Co.). US Patent 4,071,587. 31 Jan 1978. Filed date 25 Sep 1975. 8p.

A method of making a nuclear fuel element for a fission reactor is described. A solid body of an alloy of zirconium and nuclear fuel metal is exposed to hydrogen at an elevated temperature to hydride the zirconium. The hydrided alloy is exposed to oxygen at a lower temperature to form a continuous oxide layer about its exterior surface and is employed in a gastight container as a fuel element. The hydrided alloy may be exposed to oxygen at a temperature of at least about 300°C, prior to its enclosure in the container, or the hydrided alloy may be enclosed in the container together with a quantity of an oxygen-providing material, such as CO_2 or H_2O, sufficient to oxidize its exterior surface when the fuel element is raised to an elevated temperature.

33117 Publication concerning the protocol to the German/French convention on the construction and operation of a very high flux reactor and its amendment. *Bundesgesetzblatt, Teil 2;* No. 5, 80-83(Feb 1977). (In German, French, English).

Text is presented of the amendment on Great Britain's accession.

PLUTONIUM AND ISOTOPE PRODUCTION REACTORS

33118 (DUN-SA—95) **Behavior of metallic-uranium tubular fuel elements during high temperature irradiation.** Guay, A.E. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 13 Jun 1969. Contract EY-76-C-06-1857. 55p. (CONF-690609—31). Dep. NTIS, PC A04/MF A01.

From 15. annual meeting of the American Nuclear Society; Seattle, WA, USA (15 Jun 1969).

Design specifications and performance data are presented for N-reactor fuel elements. (DG)

PROPULSION REACTORS

33119 Jahresbericht 1976. (Annual report 1976). Hamburg, Germany, F.R.; GKSS (1977). 137p.

The annual report 1976 of GKSS presents a survey of R and D activities of research institutes and scientific-technical joint facilities, of cooperation with external partners, organization, financing, personnel development, and of publications, lectures, patents and lectureships.

NUCLEAR SHIPS LICENSING AND REGULATION

33120 Droit nucleaire et droit oceanique. Compte rendu du colloque. Paris, 12-13 juin 1975. (Nuclear law and law of the sea. Proceedings of the Colloquium. Paris, 12-13 June 1975). Paris, France; Economica (1977). 3-253p.

This Colloquium was held on 12th and 13th June 1975. The Proceedings, which deal with the relationship developed in recent years between both these legal systems contain the full texts of the papers submitted and the ensuing discussions between the participants. These papers discuss the technical and economic prospects of nuclear-powered ships, as well as the third party liability and licensing systems applicable to this form of navigation. The rules applicable to third party liability for maritime transport of nuclear materials and the problems raised by insurance for such transport are also described. The question of radioactive marine pollution, in particular in the light of the recent international conventions such as the 1972 London Convention, was analyzed by several speakers, while other papers dealt with the legal aspects of off-shore siting of nuclear power plants and the denuclearisation of the seabed.

REACTOR SAFETY

REFER ALSO TO CITATION(S) 33910

33121 (AES—15) **Experiments with counter current steam flow in the spray cooling facility GOETA, Studsvik.** Eriksson, S.O.; Harju, R.; Pettersson, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Mar 1977. 125p. (In Swedish). (NORHAV-S—030). Dep. NTIS (US Sales Only), PC A06/MF A01.

Experiments with counter current steam flow has been performed in a spray cooling facility with an electric simulated fuel assembly corresponding to the geometry in an ASEA-ATOM BWR type reactor. The investigation consists of two parts: main experiments with non heated assembly and control experiment with heated assembly. The results show that only very small deterioration of the spray cooling can be expected at counter current steam flow. The results are concidered to be applicable to reactors. The experiments also show that the counter-current flow limiting (CCFL) in the assembly is always followed by characteristic oscillations of the pressure difference over the assembly. These oscillations may be used as an indication of CCFL in future LOCA experiments with BWR assemblies. The experiments show that CCFL appears only when the steam velocity is higher in an assembly than in a tube.

33122 (BAW—10098(Rev.1)) **CADDS: computer application to direct digital simulation of transients in PWRs with or without scram. Revision 1.** Hsii, Y.H.; Watson, C.E.; Vasudevan, N.; Busby, S.E.; Trent, R.L. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Jan 1978. 66p. and Wilcox Co., Lynchburg, VA.

The CADDS digital computer code is used to analyze reactor transients, with or without scram, in a heterogeneous pressurized water reactor. It solves the time-dependent neutron kinetics equations in conjunction with a thermal-hydraulic solution for an average fuel pin during a reactivity transient. The simulation includes the major feedback mechanism as well as detailed single-phase nucleate boiling, transition, and stable film boiling core heat transfer models. The entire reactor coolant loop, including the pressurizer, is simulated. The steam generator model is included to evaluate the effect of feedwater variations on the steam generator as well as the primary system response.

33123 (BAW—10135) **LOCA mass and energy release for containment design.** Shieh, K.C.; Dunn, B.M. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Feb 1978. 105p. and Wilcox Co., Lynchburg, VA.

The document provides the generic model for calculating mass and energy release rates following a loss-of-coolant accident. The model is developed in accordance with the requirements in Section 6.2.1.3 of the NRC Standard Review Plan. The mass and energy release rates are used as inputs to the containment analysis code to determine the maximum containment pressure.

33124 (BMI-NUREG—1991) **HAARM-3 users manual.** Gieseke, J.A.; Lee, K.W.; Reed, L.D. (Battelle Columbus Labs., Ohio (USA)). 5 Jan 1978. 73p. NTIS, PC A04/MF A01.

Various models have been developed to describe aerosol behavior under postulated LMFBR accident conditions. Each of the codes has its own advantages and limitations regarding the accuracy of the physically realistic model of the actual aerosol behavior. The present computer code designated HAARM-3 (Heterogeneous Aerosol Agglomeration Revised Model-3) is a new version of the previous HAARM-2 and HAARM-1 models. One of the main advantages of these codes is their relatively short computing times. Therefore, these codes have been widely used for nuclear reactor safety analyses. The numerical methods employed in the present codes are based on the previous HAA-3B code which was originally developed at Atomics International. By assuming that the time dependent particle size distribution is lognormal, the integro-differential equation describing the concentration decay of aerosol is converted into three first-order differential equations. These equations with several additional first order differential equations for the generation of other desired information are integrated using a standard library subroutine. The model described in the report differs from the previous models in that all of the aerosol agglomeration and deposition mechanisms which are dependent upon the morphological properties of agglomerates are corrected using a more recent experimental density correction factor. The effects of non-spherical shape of the agglomerates on settling velocity and collision rate may also be accounted for at the user's discretion. In addition, aerosol agglomeration due to turbulence which was not included before has been added.

33125 (CEA-CONF—3848) **Key safety issues for fast breeder reactors.** Tanguy, P.; Petit, J.; Justin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1976. 8p. (CONF-761001—). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International meeting on fast reactor safety and related physics; Chicago, IL, USA (5 Oct 1976).

Safety evaluations made on the commercial 1200 MWe Creys-Malville LMFBR have shown a number of key safety issues: fuel cladding integrity, core stability, core coolability, core monitoring, shutdown systems, core disruptive accident and containment. Not one of them seems unsolvable, but studies and tests appear still

necessary, especially if it is thought in simplifying the system of increasing the unit size of the plant.

33126 (CEA-CONF—3849) **Safety test facilities. Needs and concepts. A French evaluation.** Tretiakoff, O.; Bailly, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1976. 7p. (CONF-761001—). Dep. NTIS (US Sales Only), PC A02/MF A01.

From International meeting on fast reactor safety and related physics; Chicago, IL, USA (5 Oct 1976).

The fuel behaviour of LMFBRs in the event of an accident has been tested in-pile in the SCARABEE program (local blockage, sudden flow reduction and pump coast-down at constant power). These tests will be carried on in the framework of an international cooperation on irradiated fuels: this is the purpose of the CABRI and SCARABEE N programs. All those studies should enable to assess safety margins between accident conditions and the technical specifications of the reactor. The paper explains how a logical set of simple observations has led to the present state of the Cadarache in-pile experimental safety program and how it may help to find the way in a dense forest of both technical and psychological difficulties.

33127 (CEA-CONF—3876) **Application of failure tree analysis to evaluating the reliability of a safeguard system of pressurized water nuclear power plant.** Signoret, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1976. 18p. (In French). (CONF-7606172—2). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Meeting on event trees; Paris, France (23 Jun 1976).

Event tree and failure tree analyses were used to calculate the reliability of a reactor safeguard system. Diagrams and information data on system operation were used to lay out an event tree and a failure tree in succession. The latter was then quantized using numerical data on materials failure rates. Critical paths were extracted from the failure tree after numerical calculation have been done. Weak points as regard to reliability were thus emphasized.

33128 (CEA-CONF—3877) **Applications of fault tree analysis.** Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1976. 32p. (In French). (CONF-7606172—1). Dep. NTIS (US Sales Only), PC A03/MF A01.

From Meeting on event trees; Paris, France (23 Jun 1976).

The reasons and methods of development and generalization of failure tree analysis in view of the probabilistic approach of accidents and safety quantization in the field of nuclear energy are briefly reviewed. The way of doing fault tree analysis is shown, emphasis being given on some important points: minimal cut and tie sets, failure modes and effects analysis, dependence on tests, maintenance inspection and repairs, and common mode failures. The possible quantitative and qualitative benefit lying in using the method is shown, but the difficulties thus involved are outlined.

33129 (CEA-CONF—3890) **Nuclear safety research in France.** Tanguy, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1976. 22p. (CONF-761254—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From Seminar on nuclear safety; Tokyo, Japan (17 Dec 1976).

As a consequence of the decision of choosing light water reactors (PWR) for the French nuclear plants of the next ten years, a large safety program has been launched referring to three physical barriers against fission product release: the fuel element cladding, main primary system boundary and the containment. The parallel development of French-designed fast breeder reactors involved safety studies on: sodium boiling, accidental fuel behavior, molten fuel-sodium interaction, core accident and protection, and external containment. The rapid development of nuclear energy resulted in a corresponding development of safety studies relating to nuclear fuel facilities. French regulations also required a special program to be developed for the realistic evaluation of the consequences of external agressions, the French cooperation to multinational safety research being also intensive.

33130 (CNEN-RT/DISP—77-3) **Considerations about soil-structures interaction in nuclear power plants.** Muzzi, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1977. 34p. (In Italian). Dep. NTIS (US Sales Only), PC A03/MF A01.

The main features of the soil-structure interaction for nuclear power plant are presented as they resulted from studies carried out at the Berkeley (California) University, at the California Institute of Technology and at the U.S. Nuclear Regulatory Commission in Washington (Dec 1975). The complete and inertial interaction approaches of analysis are discussed. The complete approach by the use of finite element technique as suggested by the U.S.N.R.C. Standard Review Plan 3.7.1. (June 1975) is finally described.

33131 (HEDL-TME—77-66) **Fast reactor safety technical progress report, January—March 1977.** Simpson, D.E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1977. Contract EY-76-C-14-2170. 162p. .

The report presented describes technical progress made during the reporting period, by Westinghouse-Hanford Company and supporting contractors, on fast reactor safety programs. These programs summarized include reactor safety activities supportive of the Fast Flux Test Facility and associated with development of base LMFBR technology.

33132 (JAERI-M—6788) **Report on series 2B reflood experiment.** Murao, Y.; Iguchi, T.; Sudoh, T.; Sudo, Y.; Sugimoto, J. (Japan Atomic Energy Research Inst., Tokyo). Dec 1976. 83p. (In Japanese). Dep. NTIS (US Sales Only), PC A05/MF A01.

Series 2B reflood experiment was carried out from April to May 1975, as follows: 1) injection of coolant water from the downcomer at a constant head into the test section having a flow resistance simulator of the primary loop, 2) under an atmospheric pressure, 3) in constant power density, 4) with heater rod temperature up to 600°C. The objectives are to examine quantitatively system effect and to check performance of the reflood test rig. The effect of the coolant injection mode, relation between oscillatory phenomena and core thermo-hydrodynamics, and technological problems of the test rig were observed.

33133 (JAERI-M—6849) **ROSA-II test data report, 6. (Runs 411, 314, 315, 316).** (Japan Atomic Energy Research Inst., Tokyo). Dec 1976. 142p. (In Japanese). Dep. NTIS (US Sales Only), PC A08/MF A01.

Results of the ROSA-II test simulating a loss-of-coolant accident in a light water reactor (LWR) are presented, including the test conditions and interpretation of the phenomena for test runs 411, 314, 315 and 316.

33134 (JAERI-M—6927) **Review of current topics on power cooling mismatch experiments.** Hoshi, T.; Tobioka, T.; Iwamura, T.; Kuroyanagi, T.; Takeda, T. (Japan Atomic Energy Research Inst., Tokyo). Feb 1977. 79p. (In Japanese). Dep. NTIS (US Sales Only), PC A05/MF A01.

A review is made of the current studies of fuel behavior under Power-Cooling-Mismatch (PCM) conditions as part of the light water reactor safety research program. Requirements of research in the field, both in-pile and out-of-pile, are discussed on the basis of the review including the present capability of fuel behavior analysis during a PCM accident, power reactor safety criteria, and experimental results available. Experimental plans in Japan and other countries of PCM research are also described.

33135 (MRR—168) **Results of the reliability investigations for the design basis accident 'Rupture of a cold primary coolant system'.** Hoertner, H.; Nieckau, E.; Spindler, H. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching/Muenchen (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Reaktordynamik und Reaktorsicherheit). Dec 1976. 167p. (In German). Dep. NTIS (US Sales Only), PC A09/MF A01.

This report gives a comprehensive presentation of the detailed reliability investigation carried out for the engineered safety features installed to cope with the design basis accident 'Large LOCA' of a German nuclear power plant with pressurized water reactor. The investigation is based on the engineered safety features of the Biblis Nuclear Power Plant, Unit A. The reliability investigation is carried out by means of a fault tree analysis. The influence of common-mode failures is assessed.

33136 (NTIS/PS—77/0893) **Accident risks in nuclear facilities (a bibliography with abstracts). Report for 1964-Sep 77.** Grooms, D.W. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 238p. NTIS PC N01/MF N01.

The bibliography presents risk analysis and hazards evaluation of the design, construction and operation of nuclear facilities, including the risk and hazards of transporting radioactive materials to and from these facilities. Radiological calculations for environmental effects of nuclear accidents are also included. (This updated bibliography contains 233 abstracts, 38 of which are new entries to the previous edition.)

33137 (ORAU/IEA(M)—77-29) **Summary interim report an acceptable nuclear fission future.** Ohanian, M.J.; Weinberg, A.M. (Institute for Energy Analysis, Oak Ridge, Tenn. (USA)). Dec 1977. Contract EY-76-S-05-0033. 37p. Dep. NTIS, PC A03/MF A01.

The preliminary results of the Institute's examination of the technical and institutional ways of preserving the nuclear option are presented. An acceptable nuclear future must be based not only on achieving a consensus between those in favor and those opposed to nuclear energy but, more importantly, on a consensus that develops among the general public which must weigh the arguments on both sides. Within this context, an acceptable nuclear future must be examined from the viewpoint of the three intersecting concerns of safety, proliferation, and system resiliency. The main preliminary finding of the study is that nuclear energy ought to be confined to

relatively few sites, with existing nuclear sites serving as the basis for such a policy. The key elements of a highly collocated system are described with emphasis on strenghtened security, professionalism of nuclear personnel, establishment of generating consortia, institutional longevity, and the transition from the LWR-based system to the asymptotic breeder-based system. The report concludes with brief summaries of the supporting studies in the areas of safety, siting, waste management, legislative and regulatory aspects, and proliferation issues.

33138 (ORAU/IEA(R)—77-28) **Enhancing public acceptance of nuclear energy by improving reactor safety systems.** Zivi, S.M.; Epler, E.P. (Institute for Energy Analysis, Oak Ridge, Tenn. (USA)). Dec 1977. Contract EY-76-S-05-0033. 89p. Dep. NTIS, PC A05/MF A01.

A disparity between the views of the public and of the nuclear energy community is identified, wherein the public appears most concerned about the consequences of a large-consequence reactor accident, albeit of low probability, while nuclear energy professionals concern themselves with the actuarial risks (the product of consequences and probabilities). It is proposed that an appropriate response to public concerns would be to put greater engineering emphasis on those most improbable accidents which would carry the greatest consequences. Measures are discussed that would lead to virtual assurance against an above-ground rupture of the containment vessel in a pressurized water reactor following a core-melt accident. The accident scenarios analyzed in the Reactor Safety Study (WASH-1400) are reviewed.

33139 (ORNL/NUREG/CSD—4) **RLPORINC: the RELAP4/MOD5 interface to ORINC.** Cliff, S.B. (Oak Ridge National Lab., Tenn. (USA)). 10 Jan 1978. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

The Oak Ridge Inverse code, ORINC, calculates the temperature distribution in an electric core pin from internal temperatures and the conditions in the surrounding environment. While the internal temperatures can be obtained from thermocouples in the Thermal Hydraulic Test Facility, the needed environmental conditions cannot be determined as directly from experimental data. However, this information can be determined from a modified version of the Reactor Linearized Analysis Program, RELAP. In particular, the IBM form of RELAP/MOD5 UPDATE2, as released by the Idaho National Engineering Laboratory, was modified to save the proper information in a convenient format. This document describes this RELAP-to-ORINC interface version of RELAP4 which has been named RLPORINC.

33140 (ORNL/NUREG/TM—195) **High-Temperature Gas-Cooled Reactor safety studies for the Division of Reactor Safety Research quarterly progress report, October 1—December 31, 1977.** Ball, S.J.; Cleveland, J.C.; Conklin, J.C.; Hatta, M.; Sanders, J.P. (Oak Ridge National Lab., Tenn. (USA)). 13 Mar 1978. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

Work continued on developing and refining the ORTAP-FSV code, a simulator of the dynamic behavior of the Fort St. Vrain reactor nuclear steam supply system. Preliminary comparisons were made of data obtained from a Fort St. Vrain reactor scram and predictions using the ORECA code, and the agreement was good.

33141 (PB—272686) **Some aspects of the fire hazard in nuclear power plants.** Kazarians, M.; Apostolakis, G. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jul 1977. 70p. (UCLA-ENG—7748). NTIS PC A04/MF A01.

This work is an investigation of fire as a potential threat to the safety of a nuclear power plant. A qualitative description of ignition mechanisms and factors affecting the growth of fire (detection mechanisms, extinguishing efforts, etc.) is presented and an estimate of the frequency of fires in nuclear power plants is given. Variations of the Browns Ferry fire incident are analyzed probabilistically and the results of different models are compared. Finally, the effect of using water to extinguish the fire on the probability of core damage is studied, based on the Browns Ferry actual sequence of events.

33142 (PNC-N—251-76-12(Vol.1), pp 231-248) **Vapor explosion with subcooled freon.** Henry, R.E.; Fauske, H.E.; McUmber, L.M. (Argonne National Lab., Ill. (USA)). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

A set of experiments utilizing a well-wetted system of freon and mineral oil was performed to provide a more definite test of the interface temperature representation by subcooling cold liquid. These experiments were conducted in two different manners to investigate the relative importance of the interface temperature. The first was performed with freon initially at its normal boiling point and mineral oil at the temperature ranging from 80 to 220 deg C in 10 degree increments, and the second was carried out with the mineral oil temperature held constant at 190 deg C and decreasing freon temperature from -41 to -14C deg C in 20 degree decrements. The tests were carried out in the appratus similar to that discussed in the previous report. The principal difference between the facilities is that in this case, the interaction vessel always contained freon, and hot oil was poured into the vessel. This change in contact state has little significance when freon-22 is saturated, but for subcooled freon, it provides better experimental resolution for the initial freon temperature. These experiments demonstrate that the interface temperature model not only allows to predict the explosive range of a given pair of liquids, but also enables to correlate the maximum explosive pressure which could be produced by a system which lies within the explosive limits.

33143 (PNC-N—251-76-12(Vol.1), pp 61-74) **Importance of sodium fuel interaction in fast reactor safety evaluation. CEA point of view.** Tanguy, P. (CEA, 75 - Paris (France)). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

The consequences of the interaction between molten metal (aluminum-uranium alloy) and water have long been a subject of concern for those in charge of reactor safety, following the accidents observed in BORAX, SL1, and SPERT 1D reactors. Similarly, the consequences of the possible contact between molten mixed uranium and plutonium oxides and sodium must be carefully studied, since such contact may occur in the accident conditions in sodium is explicitly mentioned in the recommendation made by a group of experts in France concerning the safety of fast neutron nuclear power stations. None of the in- or out of pile experiments carried out to date on UO_2 and sodium showed violent phenomena, except three out of pile tests by Armstrong. Recently, the work by Fauske on spontaneous nucleation and that by Board and Hall have contributed to the better understanding of the phenomena. In order to define clearly the importance of the interaction phenomena, the accident within an assembly due to blockage and the overall accident concerning a core were examined. The violent interaction caused by the blockage in an assembly is unlikely. In case of the overall accident on the core of a fast reactor, the interaction is the consequence of the retention of mechanical energy and the recovery of fuel fragments in overall cooled configuration with local cooling problems.

33144 (PNC-N—251-76-12(Vol.1), pp 341-361) **Experimental work at Harwell on the injection of sodium into liquid steel.** Asher, R.C.; Bradshaw, L.; Collett, R.; Davies, D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

The equipment and experimental technique used to inject molten sodium beneath the surface of molten steel (and subsequently molten uranium dioxide) are described. The results of an exploratory experiment, in which 2 g of sodium at 380°C were injected into 54 g of steel at 1530°C, are outlined. A violent reaction occurred, apparently as a result of a vapour explosion, and a number of pulses were recorded by a force transducer. A preliminary examination of the steel debris is reported.

33145 (PNC-N—251-76-12(Vol.1), pp 443-465) **Current status of experimental and theoretical work on sodium/fuel interaction(SFI) at Karlsruhe. Out-of-pile experiments.** Beutel, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Reaktorentwicklung); Bojarsky, E.; Caldarola, L.; Jacobs, H.; Reiser, H. 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

In April 1975, the operation of the sodium loop test facility for out-of-pile experiments started at the Institute of Materials and Solidstate Research. In this facility, it is possible to melt down single UO_2 rods and the small bundles of up to 7 rods in sodium flow by heating them electrically. The rods are subjected to power transient, starting from steady operating conditions. This gives rise to rod failure and to fuel-sodium interaction within several hundreds of msec. During the power excursion, pressure, flow, electrical voltage and current are measured. Prior to the power excursion, the conditions can be established in the cooling channels, which are comparable to those existing in the SNR fuel element. In one of the experiments, the cladding melted at the bottom of the fuel zone after the power excursion had been initiated, and liquid UO_2 was released into sodium flow. This produced very short pressure peaks in the test section. The major change of flow took place at the same time. The temperature profile inside the fuel rod was calculated with the computer program ELEKTRA. It must be concluded that the all interactions were very mild. The works in cooperation with the European Nuclear Research Center at Ispra have been carried out, and hot materials fractured in all tests, but no energetic interaction was observed.

33146 (PNC-N—251-76-12(Vol.1), pp 249-283) **Recent advances in understanding large scale vapour explosions.** Board, S.J.; Hall, R.W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

The whole process of efficient large scale vapour explosions is considered in the following three stages; a) the setting up of a quasi-stable initial configuration, b) the triggering of this configuration, and c) the propagation of the explosion. Each stage is considered in turn, with the review of the relevant experimental information and theory to see to what extent the requirements for energetic explosions, and the physical processes that can satisfy these requirements, are understood. Particular attention is paid to an attractively simple criterion for explosivity, suggested by Fauske, that the contact temperature should exceed the temperature for spontaneous nucleation of the coolant, because on this criterion, sodium and uranium oxide in particular are not explosive.

33147 (PNC-N—251-76-12(Vol.1), pp 75-95) **Experimental studies of thermal interactions at AEE Winfrith.** Briggs, A.J. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

The assessment of the consequences of very severe reactor accidents in which fuel melts involves the evaluation of the nature of any thermal interaction between the molten fuel or cladding and reactor coolant. The need for further experimental data in this area was one of the main reasons for having established the new experimental facilities at Winfrith. They provide the capability to carry out the experiments involving explosion under safe conditions by setting them up inside a strong test cell at the center of 200 m exclusive area. The instrumentation is provided for the transient measurements of pressure and strain and for high speed cinematography. The program concerned with the propagation of thermal interaction through a metal/water system was started in early 1975, and it is not yet completed. It is plausible to consider the development of large thermal interaction as a three stage process, namely mixing phase, the trigger process initiating thermal interaction, and the propagation of the interaction. With the rig THERMIR, the experiments on producing the violent interaction of tin and water and that of aluminum and water were carried out, and the characteristics of both interactions are reported. As the second stage of the Winfrith program, the UO_2/Na system will be studied, and this program is discussed.

33148 (PNC-N—251-76-12(Vol.1), pp 307-340) **Experimental study on conversion of stored thermal energy to mechanical work in fuel-coolant interaction.** Fujiie, Y.; Kondo, S.; Miyazaki, K. (Osaka Univ., Suita (Japan). Faculty of Engineering). 1976.

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

In the present study the process how the thermal energy stored in the coolant should be converted into the mechanical work is emphasized as well as the generation of pressure waves, eliminating the complicated problems involved in FCI, such as fragmentation, heat transfer from molten fuel to coolant, etc. A simulation experiment has been performed in a small scale vertical channel using stagnant potassium. Large superheat inherent in liquid metals was utilized as the method to accumulate the thermal energy. The following experimental parameters were chosen to examine their effects on the energy conversion ratio: the heat flux, the cover gas pressure, the liquid column length, the temperature of the upper unheated region and the incipient boiling superheat (corresponding to the stored thermal energy). The results are summarized that the conversion ratio from thermal to kinetic energies has increasing trends with increases of the incipient boiling superheat, the cover gas pressure and the temperature of upper unheated region, ranging over 0.02-0.75% in the present experiment.

33149 (PNC-N—251-76-12(Vol.1), pp 179-186) **Current status of experimental and theoretical work on sodium/fuel interaction (SFI) at Karlsruhe 'simulation experiments'.** Beutel, H.; Bojarsky, E.; Caldarola, L.; Jacobs, H.; Reiser, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (Germany, F.R.)). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

Experimental and theoretical work on sodium fuel interaction (SFI) is being carried out at the Nuclear Research Center of Karlsruhe (Germany) within the framework of the "Projekt Schneller Brueter (PSB). This paper concerns the description and the discussion of the experimental and theoretical results already obtained.

33150 (PNC-N—251-76-12(Vol.2), pp 651-680) **Analysis of reactor structural response to fuel sodium interaction in a hypothetical core disruptive accident.** Suzuki, K. (Nippon Atomic Industry Group Co. Ltd., Tokyo); Tashiro, M.; Sasanuma, K.; Nagashima, K. 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

This study shows the effect of constraints around FSI zone on FSI phenomena and deformations of reactor structures. SUGAR-PISCES code system has been developed to evaluate the phenomena of FSI and the response of reactor structure. SUGAR calculates the phenomena of FSI. PISCES, developed by Physics International Company in U.S.A., calculates the dynamic response of reactor structure in two-dimensional, time-dependent finite-difference Lagrangian model. The results show that the peak pressure and energy by FSI and the deformation of reactor structures are about twice in case of FSI zone surrounding by blanket than by coolant. The FSI phenomena highly depend on the reactor structure and the realistic configuration around core must be considered for analyzing hypothetical core disruptive accident. This work was supported by a grant from Power Reactor and Nuclear Fuel Development Corporation.

33151 (PNC-N—251-76-12(Vol.2), pp 751-783) **Investigations on fuel-coolant interaction with the RCN code VS-4.** Van der Putten, A.P.W.M.; Koning, H.; Van den Bogaard, J.P.A. (Reactor Centrum Nederland, Petten). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

A set of partial differential equations describing the conservation of mass, energy and momentum in a coolant channel as a function of axial coordinate and time are solved with the RCN Code VS-4, using the method of characteristics. The viscosity and turbulence of coolant are taken into account in the usual manner of technical thermodynamics by the introduction of a friction coefficient in the momentum equation. The heat transported by the axial mass flow in the subassembly is assumed to be so large that the heat transport by axial conduction may be neglected. The heat transport by conduction in the radial direction is assumed to be perfect. The calculation results are discussed and concluded as follows. (1) The method of characteristics was proved to be applicable not only to the one phase but also to the description of the honogeneous equilibrium two phase part of a thermohydraulic process. (2) To investigate the reactor safety aspects of FCI (fuel-coolant interaction) process and to evaluate the experimental research on FCI, it is indispensable to take the axial dependence effects into account. To this end, the axially dependent code VS-4 based on the method of characteristics is available. (3) At present, the thermodynamic properties of sodium according to Golden and Tokar are used in the program. To improve the accuracy of the code for high temperature and pressure, a consistent set of thermodynamic properties of sodium must be incorporated in the program.

33152 (PNC-N—251-76-12(Vol.2), pp 595-622) **Nucleation characteristics in physical experiments.** Henry, R.E.; Fauske, H.K. (Argonne National Lab., Ill. (USA)). 1976.

From 3. specialists[7] meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

Large-scale vapor explosion experiments have shown that intimate contact between hot and cold liquids, and a temperature upon contact that is greater than the spontaneous nucleation temperature of the system, are two necessary conditions for the onset of large scale vapor explosions. A model, based on spontaneous nucleation of the homogeneous type, has been proposed to describe the relevant processes and the resulting energetics for explosive boiling systems. The model considers that spontaneous nucleation cannot occur either during the relief time for constant volume heating or untill the thermal boundary layer is sufficiently thick to support a vapor cavity of the critical size. After nucleation, bubble growth does not occur until an acoustic wave establishes a pressure gradient in the cold liquid. These considerations lead to the prediction that, for a given temperature, drops greater than a critical size will remain in film boiling due to coalescence of vapor nuclei and drops smaller than this value will wet and be captured by the hot liquid surface. These results are compared to small drop data for well-wetted systems and excellent agreement is obtained between the observed behavior and the model predictions.

33153 (PNC-N—251-76-12(Vol.2), pp 819-837) **Current status of experimental and theoretical work on sodium/fuel interaction (SFI) at Karlsruhe 'code developments'.** Beutel, H. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Inst. fuer Reaktorentwicklung); Bojarsky, E.; Caldarola, L.; Jacobs, H.; Reiser, H. 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

Two computer codes have been developed. The first code contains a heat transfer model based on the inverse Leidenfrost phenomenon. The exact solution of the thermal diffusion equation for a sphere is included in the code. The time history of each fuel particle, the presence of fission gas, the size distribution of fuel particles, the effect of the friction due to channel walls, and the effect of the pressure loss at channel outlet can be taken into account. Extensive parametric study has been carried out with this code, and the main conclusions are summarized. The second code is used for the analysis of propagation effect. The interaction region can be subdivided into arbitrary number of sections, each containing fuel and coolant. The thermal conductivity of liquid sodium and the presence of non-condensing gas can be taken into account. The numerical results are generally consistent with those obtained with the first code. Vapor bubbles and their collapse seem to be the most probable mechanism of the fragmentation of UO_2 in sodium. For this reason, work has been focused on modeling this mechanism, and a preliminary model was developed. The first theoretical model for FCI developed at Karlsruhe was coupled to the American REXCO code which is available at Ispra, and the FCI subroutine is already available.

33154 (PNC-N—251-76-12(Vol.2), pp 785-817) **Model for fuel-sodium interaction. Application to the JEF experiments.** Breton, J.P.; Antonakas, D. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

A model of sodium-fuel interaction, referred to as TRACONA-BUEE, has been developed. The fuel particles are assumed to be introduced in the interacting zone within a finite mixing time, according to a given function (not necessarily linear). The equations for heat transfer inside fuel particles are those of Cho and Wright (transient conduction for phase A and quasi-steady state heat transfer for phase B). During phase B several options for heat transfer from fuel to sodium can be assumed (no transfer, transfer proportional to the volume fraction of liquid sodium, given duration of transfer, etc...) Two versions are available : a spherical one (EPISCOPOS) and an axial one (TEXAS). For application to the JEF experiments a model of heat losses along the cold column had to be introduced into TEXAS. It was found that the phenomenon is essentially governed by the heat losses. The velocity of the cold sodium in the column presents marked maxima and minima. The agreement with experiment is satisfactory.

33155 (PNC-N—251-76-12(Vol.2), pp 507-543) **Interactions with small and large sodium to UO_2 mass ratios.** Clerici, G.; Holtbecker, H.; Schins, H.; Schlittenbardt, P. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

This paper presents final results of the Ispra dropping experiments. After a brief explanation of the alteration of the experimental facility the results of experiments and their theoretical interpretations are presented. And it is concluded that the test have shown that coherent energetic explosions cannot be produced by dropping small amounts of molten UO_2 into large quantities of sodium. The second, the study of sodium entrapment is described. An experimental device to inject sodium in a UO_2 filled crucible is explained. The third part briefly describes two computer codes, Press 1 and 2. In the first one, the constraint supplied by the solidifying UO_2 shell around a sodium drop is evaluated. In the second one, a liquid-liquid contact between UO_2 and sodium is considered. Some numerical evaluations were made with these codes. Results of the evaluations of the mechanical constraint due to the solidifying UO_2 shell, and the heating and expansion of sodium in UO_2 are presented.

33156 (PNC-N—251-76-12(Vol.2), pp 877-890) **Calculations of the possible consequences of molten fuel sodium interactions in subassembly and whole core geometries.** Coddington, P.; Fishlock, T.P.; Jakeman, D. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

The possible consequences of molten fuel sodium interactions are calculated using various modelling assumptions and key parameters. And the significance of the choice of assumptions and parameters are discussed. As for subassembly geometry, the results of one-dimensional code EXPEL are compared with the solutions of the one-dimensional Lagrangian equations of a compressible fluid (TOPAL was used). The adequacy of acoustic approximation used in EXPEL is discussed here. The effects of heat transfer time constant on the behaviour of peak pressure are also analyzed by parametric surveys. Other items investigated are the length and position of the interacting zone, the existence of a non-condensable gas volume, and the vapour condensation on cold clad. As for whole core geometry, a simple dynamical model of arc expanding spherical interacting zone immersed in a semi-infinite sea of cold liquid was used (SHORE code). Within the interacting zone a simple heat transfer model (including a heat transfer time and a fragmentation time) was adopted. Vapour blanketing was considered in a number of ways. Representative results of the calculations are given in a table. Containment studies were also performed for "ducted" design and "open pool" design. The development of new codes in the U.K. for these analysis are also briefly described.

33157 (PNC-N—251-76-12(Vol.2), pp 623-650) **Review of fragmentation models relative to molten UO_2 breakup when quenched in sodium coolant.** Cronenberg, A.W. (New Mexico Univ., Albuquerque (USA)); Grolmes, M.A. 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

An important aspect of the fuel-coolant interaction problem relative to liquid metal fast breeder reactor (LMFBR) safety analysis is the fragmentation of molten oxide fuel during contact with liquid sodium coolant. A proper description of the kinetics of such an event requires an understanding of the breakup process and an estimate of the size and dispersion of such finely divided fuel in coolant. In recent years, considerable interest has centered on the problem of determining the nature of such fragmentation. In this paper, both analytic and experimental studies pertaining to such breakup are reviewed in light of recent developments in the understanding of heat transfer and solidification phenomena during quenching of UO_2 in sodium. A more extensive review of this subject can be found in Ref. 1.

33158 (PNC-N—251-76-12(Vol.2), pp 733-750) **Review of the meetings of the working group on the comparison of calculation models.** Jakeman, D. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

Physical models used in various SFI analysis codes are reviewed and the results of the comparison of productions when the codes were applied to specific test cases are presented. Several representative codes are taken up for comparisons. The features that are compared and discussed in this review paper are; the fragmentation of molten fuel; heat transfer for Stage A (single phase coolant); heat transfer for Stage B (two phase coolant); hydrodynamics; and equation of the state of sodium. A brief description of the interaction conditions applied for the test cases is given followed by the results of comparisons. Instantaneous fuel fragmentation time of 10 ms. were assumed throughout the comparison calculations. The items being compared and discussed are the peak pressure and work done in Stage A, peak pressure in Stage B, time for expulsion of sodium from channel, and the work done in expelling sodium from channel. Results of comparisons of calculated values are presented in tables and figures. One of the main conclusions drawn from these comparisons is that if expulsion times are the main interest the various treatments adopted in different codes do not lead to very different predictions.

33159 (PNC-N—251-76-12(Vol.2), pp 681-732) **Parametric study on reactor containment response to fuel-sodium interaction.** Sawada, T.; Hasegawa, Y.; Nishimura, A. (Mitsubishi Atomic Power Industries, Inc., Tokyo (Japan)). 1976.

From 3. specialists' meeting on sodium fuel interaction; Tokyo, Japan (Mar 1976).

In Proceedings of the third specialist meeting on sodium/fuel interaction in fast reactors.

Evaluations have been made on the effects of FSI parameters which affect dynamic responses of reactor containment structures. A coupled computer code FCI-II/ASPRIN-II has been employed in this study. The FCI-II code is based on a modified rate-limited model originally developed by Cho, Ivins and Wright. The ASPRIN-II code is a modified version of the reactor containment response analysis code ASPRIN originally developed by G. L. Fox. Coupling between an FSI region and its surroundings is determined by FSI zone pressure, P(V,t), as well as by FSI zone volume which is a function of constraint conditions. A spherical FSI zone in the core of a demonstration plant is assumed in this study. 1000Kg of molten fuel at 3338°K is mixed with 105Kg of sodium coolant at 900°K. The parameters changed are constraint conditions and FSI

parameters such as a fuel particle size, a rate of fragmentation and mixing, a fuel-sodium mixing ratio and a two-phase heat transfer coefficient at a fuel particle surface.

33160 (PNE—78-122) **Fragmentation requirements for detonating vapor explosions.** Patel, P.D.; Theofanous, T.G. (Purdue Univ., Lafayette, Ind. (USA). School of Nuclear Engineering). Jan 1978. 25p. Univ., West Lafayette, IN.

Sometimes the contact of a hot with a cold liquid can develop into a rapid thermal interaction in which a significant fraction of the thermal energy in the hot liquid is converted to mechanical work. Such events are called energetic thermal interactions or vapor explosions, and they have been known to man for centuries. However, the precise details of the underlying physical mechanisms remain unknown. Vapor explosions are of interest to the field of underwater vulcanism as well as to a number of industries (paper, metal, liquified natural gas, etc). However, perhaps its furthest reaching implications may be found in the nuclear power reactor industry. Here, one is concerned with the consequences of an accidental meltdown of the nuclear fuel and its interaction with the liquid coolant. The potential for an energetic fuel-coolant interaction must be assessed if adequate containment systems, which ensure that the risk to the health and safety of the public remain acceptably low, can be designed. Such assessments must include meltdown scenarios, as deduced from accident analysis considerations, and they must take into account the fundamentals of the interaction process itself. Certain aspects of these fundamentals are discussed. In particular the fragmentation aspects are examined as they pertain to the propagation process.

33161 (SAND—78-0722C) **Comments on some reactor safety study methods.** Easterling, R.G. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 23p. Dep. NTIS, PC A02/MF A01.

Observations relating to reactor safety analysis methods are presented concerning common mode failures, and failure of BWR control rods.

33162 (SKI—1977-1) **Report on safety related occurrences and reactor trips July 1, 1976—December 31, 1976.** Andermo, L. (Statens Kaernkraftinspektion, Stockholm (Sweden)). Apr 1977. 42p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This is a systematically arranged report on all reported safety related occurrences and reactor trips in Swedish nuclear power plants in operation during July 1, 1976 to December 31, 1976 inclusive. The facilities involved are Oskarshamn 1 and 2, Ringhals 1 and 2 and Barsebaeck 1. During this period of the 6 months 37 safety related occurrences and 34 reactor trips have been reported to the Nuclear Power Inspectorate. As earlier experiences have shown it is to the greatest extent the conventional components which bring about the safety related occurrences or occurrences leading to outages or power reductions. However, the component errors discovered in the safety related systems have not affected the function of their redundant systems and other diverse systems have not been involved. Therefore the reactor safety has been satisfactory. The fact that even small deviations from prescribed operation results in automatic and safe shut down of the reactor, does not always imply a conflict with operational availability. The number of reactor trips are almost as low as during the last period, which is a drastic reduction compared to earlier time periods. The greatest outages are caused by occurrences without safety significance.

33163 (WCAP—8977) **Failure Mode and Effects Analysis (FMEA) of the Emergency Core Cooling System (ECCS) for a Westinghouse type 312, three loop pressurized water reactor.** Shopsky, W.E. (Westinghouse Nuclear Energy Systems, Pittsburgh, Pa. (USA)). 1977. 80p. Electric Corp., Pittsburgh, PA.

The Emergency Core Cooling System (ECCS) is a Safeguards System designed to cool the core in the unlikely event of a Loss-of-Coolant Accident (LOCA) in the primary reactor coolant system as well as to provide additional shutdown capability following a steam break accident. The system is designed for a high reliability of providing emergency coolant and shutdown reactivity to the core for all anticipated occurrences of such accidents. The ECCS by performing its intended function assures that fuel and clad damage is minimized during accident conditions thus reducing release of fission products from the fuel. The ECCS is designed to perform its function despite sustaining a single failure by the judicious use of equipment and flow path redundancy within and outside the containment structure. By the use of an analytic tool, a Failure Mode and Effects Analysis (FMEA), it is shown that the ECCS is in compliance with the Single Failure Criterion established for active failures of fluid systems during short and long term cooling of the reactor core following a LOCA or steam break accident. An analysis was also performed with regards to passive failure of ECCS components during long-term cooling of the core following an accident. The design of the ECCS was verified as being able to tolerate a single passive failure during long-term cooling of the reactor core following an accident. The FMEA conducted qualitatively demonstrates the reliability of the ECCS (concerning active components) to perform its intended safety function.

33164 **Method and means for abruptly terminating the flow of fluid in closed fluid circulating systems of nuclear reactor plants or the like.** Schiele, O.; Florjancie, D. (to Klein, Schanzlin and Becker AG). US Patent 4,073,595. 14 Feb 1978. Priority date 2 Sep 1972, German, Federal Republic of (F.R. Germany). 4p.

A nuclear steam supply system is described wherein each of a plurality of centrifugal pumps begins to operate with full cavitation in response to an abrupt drop of system pressure in the event of leakage. This is achieved by influencing the net positive suction head of each pump over the entire range of fluid flow and/or by influencing the net positive suction head upstream of the pumps. The first mode of causing the pumps to operate with full cavitation includes an appropriate selection of the inlet angle and/or inlet diameter of pump impeller, or the provision of suitably curved guide vanes in the pumps. The second mode includes interrupting the admission of undercooled fluid into the system upstream of the pumps.

33165 **Method and apparatus for protecting the core of a nuclear reactor.** Andrews, H.N.; Roman, W.G. (to Westinghouse Electric Corp.). US Patent 4,071,403. 31 Jan 1978. Filed date 1 Aug 1974. 8p.

A method and apparatus for protecting fuel rods in a nuclear reactor core under conditions of a major break in the coolant inlet piping connected to the reactor inlet nozzle is described. A multiventuri protector which includes multiple parallel disclosed venturies is mounted in the inlet nozzle. The characteristics of the venturi protector are such that coolant flow through the protector into the reactor is unimpeded, but reverse flow through the protector is restricted when a break occurs in the inlet piping. The resistance offered to such reverse flow permits reactor coolant and emergency core coolant to remain in contact with the reactor core for a time sufficient to allow the fuel rods to decrease in temperature to a low safe level.

33166 (RISO—356) **Calculation of the individual and population doses on Danish territory resulting from hypothetical core-melt accidents at the Barsebaeck reactor.** Hedemann Jensen, P.; Lundtang Petersen, E.; Thykier-Nielsen, S.; Heikel Vinther, F. Oct 1977. Translation: source information not available. 118p. Dep. NTIS (US Sales Only), PC A07/MF A01.

Individual and population doses on Danish territory are calculated from hypothetical, severe core-melt accidents at the Swedish nuclear plant at Barsebaeck. The release fractions for these accidents are taken from WASH-1400. Based on parametric studies, doses are calculated for very unfavourable, but not incredible weather conditions. The probability of such conditions in combination with wind direction towards Danish territory is estimated. Doses to bone marrow, lungs, GI-tract and thyroid are calculated using dose models developed at Risoe. These doses are found to be consistent with doses calculated with the models used in WASH-1400.

33167 **Human engineering in nuclear reactor safety.** Farmer, W.S. (Nuclear Regulatory Commission, Washington, DC). pp 21-23 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Human interaction and intervention are recognized as playing a role in the unavailability of safety systems in nuclear power plants. Nuclear Regulatory Commission human engineering rsearch includes a recently completed initial assessment of the Human Engineering of Nuclear Power Plant Control Rooms and Its Effects on Operator Performance, an on-going effort to collect data on human error rates in nuclear power plants and planning for further studies of Safety Related Operator Actions.

ACCIDENT LIABILITY

33168 **Halsbury's laws of England. Vol. 16 pt. 2. Law of atomic energy and radioactive substances.** Sim, D.F. (UKAEA). London, UK; Butterworth (1976). 135-306p.

Halsbury's laws of England is the only complete exposition of the laws of England produced in narrative form. This book is Part 2 of volume 16 of the collection, which is devoted to legislation on electricity, atomic energy and radioactive substances. Part 2 stresses that English nuclear law is derived from international treaties and regulations and recommendations made by competent international bodies, ie the Paris Convention (NEA), the Brussels Supplementary Convention and the IAEA Regulations for the Safe Transport of Radioactive Materials. The UK legislation applicable as at 1 October 1975 is then analysed. The analysis covers the control system and safety requirements for all uses of atomic energy as well as the provisions on third party liability and compensation of nuclear damage. Finally, the functions and tasks of Euratom in research and dissemination of information, health and safety, nuclear material supplies etc..., are surveyed extensively.

33169 Nuclear Legislation, Analytical Study: Nuclear Third Party Liability. Paris; OECD (1976). 190p. (In English, French).

This is a new analysis of nuclear third party liability legislation in OECD countries, which is part of a series of studies on the major aspects of nuclear energy legislation which was started ten years ago. A first volume on this subjects was published in 1967. Since then, most OECD countries have amended their existing -or introduced new-legislation in this field. In many cases this was done in order to bring national legislation into line with the regime established by the 1960 Paris Convention on Third Party Liability in the Field of Nuclear Energy and the 1963 Brussels Supplementary Convention to the Paris Convention. These Conventions, the principles of which are described in the Introduction to the Study have been in force since 1968 and 1974 respectively. The new volume contains a standardised presentation of nuclear third party legislation in sixteen OECD countries which have, until now, adopted special legislation in this field. It describes liability regimes for operators of land-based nuclear installations as well as of nuclear ships.

33170 Aspectos Legales del Riesgo y Dano Nuclear de las Centrales Nucleares. (Nuclear hazards and damage from nuclear power plants). Tocino Biscarolasaga, Isabel. Madrid, Spain; Junta de Energia Nuclear (1975). 581p.

An in-depth study is made of the legal aspects of nuclear risk and damage in nuclear power plants, with particular emphasis on hazard prevention and compensation of damage. Following preliminary clarifications on the legal language and concepts in the regulation of nuclear power, the legal mechanism is described for hazard prevention on the installation site and during plant operation; as are the legal instruments concerning nuclear third party liability and compensation of nuclear damage. This is completed by the full texts of Spanish legislation in the nuclear field.

ENERGY STORAGE

REFER ALSO TO CITATION(S) 33359

MAGNETIC

REFER ALSO TO CITATION(S) 33522, 34266, 34267, 34274

FLYWHEELS

REFER ALSO TO CITATION(S) 33358

33171 (NTIS/PS—77/0882) **Design and applications of flywheels (citations from the NTIS data base). Report for 1964—Sep 77.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 189p. NTIS PC N01/MF N01.

The design and varied applications of flywheels and reaction wheels are investigated in these Government-sponsored research reports. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia or friction welding are reviewed. The updated bibliography contains 183 abstracts, 69 of which are new entries to the previous edition.

33172 (NTIS/PS—77/0883) **Design and applications of flywheels (citations from the Engineering Index Data Base). Report for 1970—Aug 77.** Habercom, G.E. Jr. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 187p. NTIS PC N01/MF N01.

The design and varied applications of flywheels and reaction wheels are investigated in these research reports gathered in a worldwide literature survey. Such diversified applications as satellite stabilization, surface vehicle propulsion, energy transfer devices, and inertia or friction welding are reviewed. The updated bibliography contains 190 abstracts, 57 of which are new entries to the previous edition.

THERMAL

REFER ALSO TO CITATION(S) 32919, 33272, 33273, 33281

33173 Problems of heat storage in aquifers. Werner, D. (Inst. of Geophys., ETH Zurich, CH);Kley, W. *J. Hydrol.;* 77: No. 34, 35-43(1977).

A hydrothermic field experiment near Krefeld (Federal Republic of Germany) has been used to study the propagation of heat in groundwater. For two months water at a temperature of 45°C was fed through a well pipe to the water-bearing strata, the distribution of temperature in the surrounding space was measured and its variation with time was observed. A theoretical model has been developed to simulate the field experiment. This consists of time—space differential method with the help of which good conformity between theory and experiment is obtained. The aim of this study is to ascertain the physical bases for the storage of heat in groundwater. This techno-economic and environmental probelm is posed because of the enormous quantities of cooling water necessary in the operation of atomic power stations. A functional theoretical model can help to decide how far the idea of storing heat in an aquifer is technically feasible.

33174 Heat storage furnace. Hellmann, D. (to Kueppersbusch und Soehne A.G., Gelsenkirchen (Germany, F.R.)). German(FRG) Patent 2,250,958/B/. 28 Apr 1977. 4p. (In German).

The invention concerns a heat storage furnace, in which hot air taken through the core of the store is to be mixed with cold air taken through a by-pass channel, so that a nearly constant air mixture temperature is produced. The cross section of the opening of the by-pass channel can be changed by a flap, which is controlled by a bimetal strip situated in the outgoing air flow. According to the invention one leg of the U shaped bimetal strip is situated immediately in the temperature region of the store core, and the other leg is situated in the path of the air taken through the by-pass. With the store core fully charged, the outlet cross section of the by-pass channel is open to the fullest extent and the outlet opening for the air taken through the store core is blocked as far as possible. If the store core temperature falls and lowers the temperature of the heated air, the U-shape of the bimetal strip opens, so that the flap reduces the opening crossection of the by-pass channel, and simultaneously more air enters the mixing channel from the store core.

33175 Thermal accumulator with charging device, in particular for drives. Laing, N. German(FRG) Patent 2,542,370/A/. 24 Mar 1977. 7p. (In German).

The patent describes a heat accumulator for latent-heat storage at high temperatures, in particular heat accumulators for power supply to thermodynamic drives. Steam with a temperature higher than the crystallization temperature of the accumulator material is led through the accumulator. The energy stored is led into a thermal useful circuit and is used again.

BATTERIES

REFER ALSO TO CITATION(S) 33511

DESIGN AND DEVELOPMENT

33176 (ANL—77-75) **High-performance batteries for stationary energy storage and electric-vehicle propulsion. Progress report, July—September 1977.** (Argonne National Lab., Ill. (USA)). Jan 1978. Contract W-31-109-ENG-38. 82p. Dep. NTIS, PC A05/MF A01.

Research activities on lithium/metal sulfide batteries during the period July to September 1977 are described. These batteries are being developed for electric-vehicle propulsion and stationary energy storage. The present cells, which operate at 400 to 500°C, are of a vertically oriented, prismatic design with a central positive electrode of FeS or FeS_2, two facing negative electrodes of lithium—aluminum alloy, and an electrolyte of molten LiCl—KCl. The ultimate goal of this work is competitive, self-sustaining industry for the commercial production of lithium/metal sulfide batteries. Technology transfer is being implemented by several means. Tests provide information on the effects of design modifications and alternative materials for cells. Plans were laid for the construction of a 100-cell test facility, and a prototype 100-A cell/battery cycler was designed and built. Improved electrode and cell designs are being developed and tested. Among the concepts receiving attention are carbon-bonded positive electrodes, pellet-grid electrodes, alternative materials for positive electrodes, additives to extend electrode lifetime, and alternative electrode separators. Materials development efforts include the development of improved electrical feedthroughs, investigations of various types of electrode separators, corrosion and wettability studies of materials, and post-test examinations of cells. Cell chemistry studies are concerned with phases formed in FeS_2 electrodes, sulfur vaporization rates for FeS_2 and NiS_2, and cyclic voltammetry measurements of metal sulfide electrodes. Titanium disulfide positive electrodes as well as liquid lithium negative electrodes are also being investigated. The use of calcium and magnesium alloys for the negative electrode is being investigated. 16 figures, 13 tables.

33177 (ANL—78-20) **Development of lithium/metal sulfide batteries at Argonne National Laboratory: summary report for 1977.** (Argonne National Lab., Ill. (USA)). Mar 1978. Contract W-31-109-ENG-38. 40p. Dep. NTIS, PC A03/MF A01.

Highlights for 1977 of Argonne National Laboratory's program on the development of lithium/metal sulfide batteries are

presented. Intended applications are electric-vehicle propulsion and stationary-energy-storage applications such as load-leveling. The battery cells consist of a lithium—aluminum or lithium—silicon alloy negative electrode, an FeS or FeS_2 positive electrode, and a molten LiCl—KCl electrolyte, which requires an operating temperature of 400 to 450°C. Most of the cells tested during the year were of a prismatic design, with capacities in the range of 100 to 200 Ah. Subcontracts were continued with industrial firms on the development of cell fabrication techniques and fabrication of electrical feedthroughs and electrode separators. Proposals were solicited for the development, design, and fabrication of a 40 kWh battery to be tested in an electric van early in 1979. After testing the 40 kWh battery, electric-vehicle batteries with higher performance, longer lifetime, and potentially lower cost in mass production will be fabricated. Conceptual designs for a 6 Mwh battery module for stationary energy storage were completed. Cells of about 4 kWh capacity are to be assembled into submodules. Nearly 200 cells were fabricated by industrial subcontractors in 1977 for testing; approximately 45 additional cells of various designs were fabricated and tested at ANL to evaluate different types of electrodes, current collectors, separators, and other cell components. Work was continued on the development and testing of materials for various cell components, and post-test examinations of cells were made to evaluate the behavior of cell materials and to determine the causes of cell failure. Chemistry studies during the year were concerned primarily with the electrochemistry of FeS_2 and NiS_2 electrodes. 10 figures, 6 tables.

33178 Sodium—sulfur type electric cell. Mehaute, A.L.; Bordet, P. (to Compagnie Generale d'Electricite). US Patent 4,076,900. 28 Feb 1978. Priority date 20 Nov 1975, France. 4p.

An electric cell of the sodium—sulfur type particularly adapted for undergoing complete recharging is described. It comprises a cathode tank containing sulfur and an anode tank containing sodium. These reagents are separated by a solid electrolyte tube disposed in the cathode tank fitted with graphite felt washers to ensure cathode collection of the current generated; the electrolyte tube is surrounded by a grating which is connectable to the negative terminal of te recharging current source by means of a resistor. The invention is used in cells for electric vehicles. 2 figures.

33179 Alkaline lead battery. Lindstrom, O.B. (to AB Olle Lindstrom). US Patent 4,076,909. 28 Feb 1978. Filed date 17 Jan 1977. 8p.

An accumulator battery, which may be called an alkaline lead battery, uses as negative material the typical electrode anode materials of the alkaline battery, e.g., iron, cadmium, etc., and as positive material lead dioxide or other difficultly soluble lead (IV) compounds which are formed by the addition of anions like sulphate, etc., to the alkaline electrolyte. During discharge the positive electrode material is reduced to lead (II) compounds containing the anion added to the electrolyte. The electrolyte has alkaline reaction during the whole cycle of charge and discharge. 5 figures.

33180 Cell having chalcogenide cathode and solvated alkali metal salt electrolyte. Francis, R.W.; Newman, G.H. (to Exxon Research and Engineering Co.). US Patent 4,075,397. 21 Feb 1978. Filed date 1 Mar 1977. 6p.

A novel electrochemical cell has the following components: an anode which contains as the anode-active material an alkali metal; a cathode which contains as the cathode-active material a chalcogenide of the empirical formula M'A/sub p/, wherein M' is one or more metals selected from the group consisting of titanium, zirconium, hafnium, niobium, tantalum, and vanadium, A is one or more chalcogens selected from the group consisting of oxygen, sulfur, selenium, and tellurium, and p is a numerical value between about 1.8 and about 3.2; and a solid electrolyte consisting essentially of one or more solvated metal—alkali metal—halogen compounds of the formula ZMX/sub n/, wherein Z is an alkali metal, M is a metal selected from the group consisting of Zn, Cd, B, Al, Ga, In, Tl, Sn (stannous), P, and As, X is one or more halogens selected from the group consisting of chlorine, fluorine, bromine, and iodine, and n is a numerical value equal to one plus the valence of the metal M. Preferred are the cells wherein the anode is lithium, the cathode contains as its cathode-active material TiS_2, and the electrolyte consists essentially of a solid solvated metal—lithium—halogen salt.

MATERIALS, COMPONENTS, AND AUXILIARIES

REFER ALSO TO CITATION(S) 33269, 33399, 33643

33181 Device for pulse charging of chemical current sources. German, A.N.; Vinogradov, G.V.; Anokhin, N.N.; Prudnikov, V.F. *Sov. Electr. Eng. (Engl. Transl.);* **47**: No. 5, 95-96(1976).

A pulse charging device (for fast storage-battery charging) using power thyristors is described; it generates charge-discharge pulses with regulation of output-pulse duration in utilization of the ac commercial network.

33182 High-temperature method of operating a lead—acid cell. Fritz, H.P.; Besenhardt, J.; Rauschenbach, G. (to Rheinisch-Westfalisches Elektrizitatswerk AG). US Patent 4,076,901. 28 Feb 1978. Priority date 20 Oct 1975, German, Federal Republic of (F.R. Germany). 8p.

A lead—acid storage cell is operated at a temperature of about 70°C. It comprises a positive electrode which, in the charged state, carries an active mass consisting predominantly of lead dioxide, a negative electrode consisting predominantly of lead in the charged condition, and a sulfuric acid electrolyte. To permit the storage cell to operate at the elevated temperature without deterioration, the negative electrode is provided with a sheath permeable to the electrolyte but impermeable to particles released from the negative electrode. The sheath, which may constitute the interelectrode separator, can consist of a nonwoven or woven fabric of glass fiber or a nonwoven or woven fabric of unsubstituted or perhalogenated polyolefin or a layer of ceramic. The electrolyte in the cell is covered by a vaporization-resistant layer consisting of floating solid particles or a liquid which is unaffected by the high operating temperature. The battery or cell can be heated so as to permit its discharge, for example, at the aforementioned optimum temperature of about 70°C. 2 figures.

33183 Sodium—sulfur storage battery. Senoo, K. (to Agency of Industrial Science and Tech.). US Patent 4,076,902. 28 Feb 1978. Priority date 11 Nov 1975, Japan. 4p.

A sodium—sulfur storage battery has a sealed housing which contains a solid electrolyte incorporating an anodic reactant such as sodium, a cathodic current collector (which may be the housing) extending in a direction generally parallel to the solid electrolyte, and cathodic electroconductive material disposed between and in contact with the solid electrolyte and the cathodic current collector. The cathodic electroconductive material is impregnated with a cathodic reactant and includes a fiber content, the individual fibers of which have a direction normal to the direction of the cathodic current collector. One suitable material for the cathodic electroconductive material is a graphite felt impregnated with sodium polysulfide or sulfur. 5 figures.

33184 Alkali metal—sulfur cells. Sudworth, J.L.; Bird, J.M. (to British Railways Board). US Patent 4 076,903. 28 Feb 1978. Priority date 16 Aug 1975, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

An alkali metal—sulfur cell has an outer tubular casing and an inner tubular solid electrolyte dividing the cell into anode and cathode compartments whose interior provides one of such compartments. The outer tubular casing and the tubular solid electrolyte are spaced apart to define an annular space, which provides the other compartment of the cell. A primary porous coating is provided on at least one surface of the solid electrolyte and an outer layer is provided on the primary porous coating, the outer layer being more dense than the primary porous coating. 4 figures.

33185 Electrode for electrical energy storage device. Sammells, A.F. (to Rockwell International Corp.). US Patent 4,076,905. 28 Feb 1978. Filed date 5 May 1977. 14p.

An improved lithium electrode structure comprises an alloy of lithium, silicon, and boron in specified proportions and a supporting current-collecting matrix in intimate contact with the alloy. The lithium electrode of the present invention is utilized as the negative electrode in a rechargeable electrochemical cell. 5 figures, 3 tables.

33186 High energy density battery with dioxoland based electrolyte. Garth, B.H. (to E. I. Du Pont de Nemours and Co.). US Patent 4,071,665. 31 Jan 1978. Filed date 29 Jul 1974. 10p.

High-energy-density galvanic batteries having high utilization of active electrode material are prepared by using voltaic cells having lithium anodes, cathode depolarizers reducible by the anodes such as cupric sulfide, and electrolytes comprising a dioxolane as solvent and up to about 20 weight percent of a conductive, nonreactive electrolyte salt such as lithium perchlorate dissolved therein. Optionally, up to 50 weight percent of the solvent can be a second solvent which is an aliphatic or cycloaliphatic carbohydric ether to reduce battery gassing. Additional small amounts of a tertiary nitrogen base can be added to suppress the tendency of the electrolyte system to form polymer. 2 tables.

33187 Efficient sodium/sulfur battery. King, R.N.; Mitoff, S.P.; Breiter, M.W. (to Electric Power Research Inst., Inc.). US Patent 4,070,527. 24 Jan 1978. Filed date 13 Aug 1976. 6p.

Improved sodium/sulfur batteries are provided by enhancing the utilization of active positive-electrode material. In sodium/sulfur batteries, employing a liquid sodium electrode separated from a liquid sulfur electrode by a solid β-alumina electrolyte separator, where the sulfur is impregnated in an electronically conducting matrix such as porous carbon, enhanced utilization of active electrode material is achieved during the charging—discharging cycling by enhancing the electronic resistivity adjacent the β-alumina in the sulfur electrode. This can be achieved in a variety of ways, particu-

larly by employing porous carbon of higher resistivity adjacent the β-alumina as compared to the porous carbon distant from the β-alumina. 2 figures.

33188 Baking of MgO-stabilized Na-β-alumina. Willmann, G. (Cremer-Gruppe, Roedental (Germany, F.R.). Forschungsinstitut); Heimke, G. (Friedrichsfeld G.m.b.H., Steinzeug- und Kunststoffwerke, Mannheim (Germany, F.R.)); Haar, W. (Brown, Boveri und Cie A.G., Heidelberg (Germany, F.R.). Zentrales Forschungslabor). *Ber. Dtsch. Keram. Ges.;* **54**: No. 11, 380-381(Nov 1977). (In German).

As solid electrolytes in Na/S accumulators, thin-walled tubes of MgO-stabilized Na-β-aluminum oxide, sealed on one side, are required. The processes during the baking of these tubes are briefly described. Components with a fine-grained structure and high density may be prepared by a special baking process. The specific resistance of the components may be further reduced by subsequent tempering.

APPLICATIONS

REFER ALSO TO CITATION(S) 33315

ENERGY MANAGEMENT AND POLICY

ENERGY ANALYSIS AND MODELING

REFER ALSO TO CITATION(S) 32812, 32813, 33201, 33209, 33215, 33216, 33227, 33241, 33253, 33254, 33255, 33256, 33259, 33260, 33263, 33719

33189 Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977). 642p. (CONF-770438—P1). Society of America, Pittsburgh.

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

A separate abstract was prepared for each of 26 of the 107 papers in Part 1; two papers were processed previously. All of the abstracts will appear in Energy Research Abstracts (ERA); thirteen were selected for Energy Abstracts for Policy Analysis (EAPA).

33190 Energy model for Mississippi. Hotard, D.G.; Parker, M.W. (Mississippi State Univ., State College). pp 73-76 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A model for energy flows in the state of Mississippi has been developed. The model identifies all sources of energy entering or appearing in the state, the uses of energy within the state, and all energy leaving the state or diverted to non-energy uses. The model updates monthly. Current research centers on refinement of the model.

33191 Energy-planning model for Pennsylvania. Elchak, T.; Raphael, D.L. (Pennsylvania State Univ., University Park). pp 77-81 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

This paper presents an energy model of Pennsylvania, examining the interrelationships of the various energy supply, conversion, and consumption sectors of the energy network. To evaluate the model, real data for energy production, conversion, and consumption for Pennsylvania for the year 1972 have been collected and analyzed. The analytical tool used to evaluate this information was a complex linear flow model. After initial model construction and analysis, hypothetical energy scenarios were examined utilizing the linear flow model structure, and also, by optimizing energy transfers using a goal programming model coupled with the linear flow model.

33192 USRNG: a model of the United States energy system. Leff, A.A.; Vastola, F.J. (Pennsylvania State Univ., University Park). pp 83-87 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

USNRG is an energy flow model that provides a twenty-nine year energy production and distribution data base. The data is available from polynomials closely approximating the real data. The system utilizes a least squares fitting technique to provide fast means of examining future scenarios. USNRG is designed to operate in a mini-computer.

33193 Review of energy-model techniques, environmental impacts, and control policies. Kim, R.H.; Wehe, A.H. (Environmental Protection Agency, Research Triangle Park, NC). pp 89-93 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

There have been many recent investigations on modeling techniques which are needed to predict either national or regional energy supply-demand options. These investigations provide and apply a framework and associated data base for analyzing regional socio-economic and environmental impacts of energy development program and policies. This paper reviews the existing modeling techniques and identifies which modeling techniques can be used in determining SO_2 emissions resulting from energy supply-demand options. The Battelle-Columbus—EPA model, the National Coal Model, and the Project Independence Evaluation System are found to be useable with some deficiencies in the models. These deficiencies are: (1) effect of income on energy demand, (2) effect of fuel price on the cost of electricity, (3) inclusion of the agricultural sector as a demand sector, (4) extra handling expenses for low-sulfur coal (LSC), and (5) effect of LSC on size of particulate control devices.

33194 Structure of a simulation model for automobile use, gasoline consumption, and environmental decay. Resek, R.W. (Univ. of Illinois, Urbana); Springer, R.K. pp 191-195 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A simulation model is developed for energy and pollution. Separate equation sets for automobile purchase, automotive stock, gasoline consumption pollution input to the system, and pollution levels are employed. Specific policies concerning pollution are contrasted.

33195 Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977). 540p. (CONF-770438—P2). Society of America, Pittsburgh.

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

A separate abstract was prepared for each of 13 of the 89 papers in Part 2; one paper was processed previously. All of the abstracts will appear in Energy Research Abstracts (ERA); eleven were selected for Energy Abstracts for Policy Analysis (EAPA).

33196 Structure and organization of a National/Interregional Agricultural-Projections-Systems simulation model. Jaske, M.R. (Dept. of Agriculture, Washington, DC). pp 707-712 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

The NIRAP model described in this paper is designed to project likely values for key agricultural commodity production levels and prices in the United States over a long-run time horizon in the range of 5 to 50 years. These projections are routinely used by other Federal agencies, state governments, and private agricultural interests as an input to their own strategic planning. Component models used within the current NIRAP system have been drawn from several divisions within ERS. This paper describes the newest effort at system-model development, which has as its major thrust the integration of existing component models with newly designed ones to create a dynamic simulation model following systems principles. It is hoped that this effort will improve the future projections ability, as well as open up a policy evaluation capability which has until now been limited.

33197 Simulation: uses and pitfalls. Aburdene, M.F. (Swarthmore Coll., PA). pp 771-774 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

This paper discusses the uses, purposes, and pitfalls of simulation techniques, with emphasis on the pitfalls. The pitfalls are classified into two categories: human misuses and misapplications, and the inherent limitations of simulation. The paper is of special interest to the users of social-system simulations.

33198 Computer model of the United States. Monteen, L.; Swisher, G. (Tennessee Technological Univ., Cookeville). pp 787-790 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

A Forrester-type growth model was developed using SL-1 (Xerox simulation language). This model interrelates the dynamic variables of population, natural resources, food supply, land use, energy needs, employment, capital investment, and pollution.

33199 Prediction of low-probability adverse events in Panel versus Delphi groups. Moskowitz, H.; Kimpel, C.H. (Purdue Univ., West Lafayette, IN). pp 837-843 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

A key characteristic of many societal decision problems is the rare likelihood of occurrence of a catclysmic event, such as a nuclear reactor failure. An accurate assessment of such rare events is difficult, nigh impossible, according to many critics. The fractile method of assessing subjective probability distributions is used to examine whether panel and Delphi-group formats and prior experience with the event improve the assessment of somewhat-extreme quantities. Revised assessment procedures are also suggested.

33200 Integrating technology assessment techniques. Burke, T.E. (Clemson Univ., SC); Adelman, L.; Kruzic, P.; Sheridan, T.B.; Kawamura, K.; Malone, D.W.; Wakeland, W. pp 963-969 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

This paper describes an approach to the preliminary stages of a technology assessment which exploits and integrates unique features of individual tools, including Group Dialog, ISM, KSIM/QSIM, and Policy Capturing. A pilot demonstration at the Second International Congress on Technology Assessment involved seven practitioners and 36 conference participants. Key issues surrounding electronic funds transfer were explored during the exercise. Substantive results of the demonstration are summarized and conclusions made regarding the value of this integrated approach.

ECONOMICS AND SOCIOLOGY

REFER ALSO TO CITATION(S) 32617, 33198, 33213, 33239, 33243, 33261, 34314

33201 (AD—044908) **The Stanford PILOT energy/economic model. Technical report.** Connolly, T.J.; Dantzig, G.B.; Parikh, S.C. (Stanford Univ., Calif. (USA). Systems Optimization Lab.). Jul 1977. Contract N00014-75-C-0865. 50p. (SOL—77-19). NTIS PC A03/MF A01.

The PILOT Energy Modeling Project is concerned with: (1) performing modeling and methodology research dealing with construction and solution of reasonably large-scale mathematical programming models of energy/economic systems; (2) using modeling research towards analysis of some of today's important energy questions; and (3) using the modeling and methodology to construct better models for improved analysis of tomorrow's important energy questions. At the core of this project is the development of a multisector, intertemporal linear-programming modeling system that describes in physical terms many of the technological interactions within and across the sectors of the American economy. The general aim of the modeling effort is to permit studies to assess (1) how specific energy policies will affect the energy supply/demand picture and (2) how the physical capacity of the economy over the next 30-35 years to provide goods and services to its populace could be affected by changes in energy supply. Intertemporal linear-programming models of the energy sector and the economy provide a unique medium for exploring future energy policy options.

33202 (DOE/EV—0001) **Plan is not necessarily a four-letter word.** House, P.; Shull, R.; Williams, T. (Department of Energy, Washington, D.C. (USA). Office of Institutional Research and Analyses). Jan 1978. 38p. (CONF-780101—). Dep. NTIS, PC A03/MF A01.

From White house conference on balanced national growth and economic development; Washington, DC, USA (Jan 1978).

The purpose of this paper is to remove the topic of "planning" from being the sole property of the academic and technocrat and to bring it to the political arena in a form understandable to the principal players there--the politicians. The authors try to explain what the fuss over planning has been all about and what legacy of opinions and confusion the politician takes on when he addresses the issue. To better focus the arguments, a series of options were laid out of tasks for planning to perform and then, through the technique of recalling major Congressional and Executive programs, relating these planning options to evaluations of what might have made the programs more responsive or successful. The upshot of the analysis was that the type of planning apt to have the greatest payoff with the least political risk was a form largely dedicated toward getting the public sector's own house in order. The paper then turns to addressing where such a planning function might be housed. No option is omitted on a priori grounds, as determination and cash solve all problems. On the other hand, it does appear that some effort in this direction is necessary in the Executive Branch. The authors then move from the general to the specific and propose a strawman design for such an Executive Branch group and calculate how much it would take to put it in place. (From Summary)

33203 (HCP/L60866—01) **Development of a financial management program for City of Gillette and Town of Moorcroft. Final report. Volume I. Project summary.** (Lankford (Duane G.) and Co., Denver, Colo. (USA); Ernst and Ernst, Denver, Colo. (USA)). 15 Jul 1977. 39p. (FEA—77-8-5(Vol.1)). Dep. NTIS, PC A03/MF A01.

Because of the availability of strippable low-sulfur coal deposits, the energy-rich western states are expected to play a major role in supplying the nation's future energy needs. When large-scale energy resource development occurs within a short period of time in an area unaccustomed to such sudden growth, local government revenues and capital investment in the local services sector fail to keep pace with growing demands. The severity of socio-economic impacts depends upon the type of development, original population size, rate of growth, location, existing local services and facilities, quality of planning, adequacy of financial management system, etc. The problems are complicated by the fact that population influxes peak in the early years of development when communities are least able to cope. As a result, housing, public facilities, and local service may not be able to keep pace with the demands of the growing population. This report responds directly to a Request For Proposal, dated December 7, 1976, prepared by the City of Gillette, Wyoming with the advice and assistance of the State of Wyoming Department of Economic and Planning Development. This is one of four volumes that comprise the study. (MCW)

33204 (HCP/U6046—01) **Manpower for energy research: a comprehensive manpower information system for energy research, development, and demonstration.** Goldstein, H. (Kramer Associates, Inc., Washington, D.C. (USA)). Feb 1978. Contract EC-77-C-01-6046. 327p. Dep. NTIS, PC A15/MF A01.

The study was designed to assist ERDA in its mission of encouraging, supporting, and conducting R, D, and D programs aimed at improvement and expansion of energy resources and capabilities. The project constitutes the first step in such an effort--the specification of a Comprehensive Energy Manpower Information System (CEMIS). The study focused on existing information, identified what is available, and evaluated its utility in the logical structure. Then, the statistical improvements and innovations considered essential for the purposes of RD and D policy formulation and program management are proposed. It is concluded in the study that there may be advantages in mechanizing the storage and retrieval of presently available data sources, but computerization for the purpose of programmed data manipulation does not at this point appear to be feasible. (MCW)

33205 (P—6033) **Charging up for electrical-rate reform.** Acton, J.P. (RAND Corp., Santa Monica, Calif. (USA)). Nov 1977. 5p. Corp., Santa Monica, CA.

The philosophy of peak-load pricing and its application by the Los Angeles Department of Water and Power are discussed. The largest commercial and industrial users of electricity would be on peak-load rates from the outset. Medium-sized commercial and industrial users would be included when metering equipment became available. The remaining customers would pay a single price per kWh which would not vary by time of day but would be determined by the average of peak and off-peak usage. It is felt that the increased cost of doing business would be slight. (RWR)

33206 (PB—272884) **Scientific and technical personnel in energy-related activities: current situation and future requirements. Final report 1974—1985.** Folk, H.; Dauffenbach, R.; Fiorito, J.; Gilmore, D.; Hendricks, W. (Illinois Univ., Urbana (USA). Center for Advanced Computation). 1 Jul 1977. Contract NSF-C-1045. 327p. NTIS PC A15/MF A01.

A wide range of labor-market indicators was examined for the period 1972-75 for energy-related scientific and technical personnel. While no critical shortages were noted, there was a trend in tightening of the job market for some specialties. For any of three assumed energy-use scenarios, energy-related employment requirements of scientists and engineers is expected to grow at about 3 percent per

year between 1974 and 1985. Compared to the base year 1974, the proportion of scientists and engineers involved in energy production, 13 percent, would not change significantly.

33207 (TID—28201) **Socioeconomic impact mitigation mechanisms in six states: categories, generalizations, and unresolved issues.** Gilmore, J.S.; Flory, D.K.; Hammond, D.M.; Moore, K.D.; Coddington, D.C. (Denver Research Inst., Colo. (USA); Bickert, Browne, Coddington and Associates, Inc., Denver, Colo. (USA)). Sep 1977. Contract EX-77-C-03-1379. 41p. Dep. NTIS, PC A03/MF A01.

In some areas, the development of new supplies creates or threatens change in existing social and economic relationships. In others, uncertainty about taken-for-granted sources or supplies of energy similarly raises anxiety. Where these actual or threatened changes are seen as disruptive, negative socio-economic impacts are occurring. Since such impacts and social or political responses to them may impede energy development or substitution, they are of concern to energy-related governmental agencies. Since negative impacts may affect the health, safety, and welfare of citizens, communities, and states, they concern general-purpose governments at all levels. However, there is great variation among different states as to the problems, state perceptions of the problems, and the institutions (or the institutional impediments) for dealing with the problems. Some comparative examination is appropriate to see if any commonality of problems exists or if any useful generalizations can be made. The project was based on literature search and interviews carried out in the six weeks following the President's April 20, 1977 energy message. These inquiries had two objectives: (1) to identify the sorts of energy development (or major shifts or substitutions in energy supply) in the states; and, (2) to identify both perceptions of anticipated socio-economic impacts and state-mitigation mechanisms for dealing with negative impacts. Inquiry was made only in six state capitols (Colorado, Illinois, Kentucky, Louisiana, Massachusetts, Montana), not in the localities with new or anticipated energy activities. (MCW)

33208 **Energy, the Heckscher-Ohlin theorem, and U.S. international trade.** Hillman, A.L.; Bullard, C.W. III. *Am. Econ. Rev.;* **68**: No. 1, 96-106(Mar 1978).

An empirical model of U.S./foreign transactions shows the U.S. to have a comparative advantage in labor-intensive output and a disadvantage in an energy-capital input. The labor-intensive advantage is apparent when traded goods are defined to include intra-industry trade and when sectors are identified by their net trade balance. The findings of Leontief and Baldwin that import-competing production is relatively labor-intensive is substantiated. The model used incorporates energy as a third input to determine the outcome of energy conservation. The export of labor and capital during the 1960s is shown to balance the import of energy, although complimentarity can be demonstrated for energy-labor only. 25 references.

33209 **Social choice about technology.** Nicholson, H.J. (Purdue Univ., West Lafayette, IN). pp 787-836 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

The costs, risks, and benefits of implementing a particular technology are not immediately obvious. The most important benefits are those which the intended beneficiaries believe will benefit them; the most-important risks are those which the persons at risk deem critical. A descriptive model is presented that "maps" the perceptions and values of major actors and groups of affected citizens in response to technological innovations. Illustrations are presented from three empirical case studies based upon interviews.

ENVIRONMENT, HEALTH, AND SAFETY

REFER ALSO TO CITATION(S) 32616, 33193, 33194, 33239, 33675, 33715, 33716, 33719, 33731, 34026

33210 (LBL—6871) **Potential electricity impacts of a 1978 California drought.** Siri, W.E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 139p. Dep. NTIS, PC A07/MF A01.

California has endured severe droughts both in 1976 and 1977. As a consequence, surface-water supplies during 1977 decreased to levels not experienced in the recent history of California. Hydroelectric supplies, which rely on surface runoff, also decreased to record lows raising questions regarding the adequacy of electricity supplies to meet summer peaks during 1977 and 1978. Through 1977 electricity supplies, aided by conservation of electricity by consumers, power pooling, and other measures were adequate to meet demand. However, supplies were more expensive due to increased reliance on thermal generation to compensate for hydroelectric losses. The continuance of the drought for another year is analyzed in this study. To analyze the impact of supply options on reliability and electricity prices, two separate models were modified and implemented. These models along with the overall methodology, although implemented primarily with data for 1978, would be generally applicable for analyzing the adequacy of electricity supply during any year. In this analysis, electricity demand and supply during 1977 are reviewed before analyzing the prospective situation during 1978. Hydroelectric supplies for 1978 are assumed at the level anticipated by the electric utility companies. These supply estimates are based on the 1977 levels of runoff. The hydroelectricity thus generated would be slightly lower than that estimated for 1977. Also on the supply side, because of the uncertainty associated with the introduction of the Diablo Canyon 1 nuclear power plant, the supply options with and without Diablo Canyon Unit 1 are analyzed. The major findings of the study are discussed.

33211 **Environmental council shifts focus from the budget to DoE's programs.** *Energy Res. Rep.;* **4**: No. 2, 3-5(23 Jan 1978).

An interview with James J. MacKenzie of the Council on Environmental Quality staff describes the Council's role in reviewing the budget and advising the President when his policies are not reflected. The budget review, focusing on solar energy in 1977, was primarily concerned that government energy programs be integrated with environmental programs, although the council has no oversight role. A memorandum of agreement between the two groups and adequate environmental programs within DOE are seen as two ways to improve cooperation between the two groups. Mr. MacKenzie recommends the development of photovoltaic cells, with additional fossil and nuclear plants constructed only when no conservation or solar alternative can relieve the need for a new plant, although he acknowledges the land-use and mineral problems of solar technology. He sees the solution of coal-mining and coal-burning problems to be political as well as economical and recommends taxes in favor of tax credits to encourage coal substitution at realistic prices.

ENERGY RESOURCES

REFER ALSO TO CITATION(S) 33207

33212 (BNWL-RAP—19) **Energy and water consumption of Pacific Northwest irrigation systems.** King, L.D.; Wensink, R.B.; Wolfe, J.W.; Shearer, M.N. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1977. Contract EY-76-C-06-1830. 159p. Dep. NTIS, PC A12/MF A01.

Irrigation in the Pacific Northwest is an energy-intensive process which represents a major part of the total energy used in farm level food production. Since 1950, several major developments have precipitated pronounced increases in irrigation energy requirements. For example, the invention of efficient high-lift pumps, labor-saving equipment, new uses for irrigation sprinklers, and profitable cropping patterns have substantially escalated irrigation energy consumption in the Pacific Northwest in the past 25 years. Until recently, energy prices have remained relatively low and constant. The next 25 years will continue to experience advanced irrigation technologies. In addition to technological development, however, the cost of energy and water will certainly rise while their availabilities become increasingly constrained. The depletion of ground water in several parts of the United States could also potentially increase the irrigation burden of the Pacific Northwest. Lastly, parts of the Pacific Northwest water supply are directly convertible to energy via hydroelectric generation. This study proposes to make realistic projections relative to present and future interactions of the above components.

33213 **Changing nature of industrial chemistry.** Davies, D.S. (Dept. of Industry, London). *Chem. Eng. News;* **56**: No. 10, 22-27(6 Mar 1978).

Trends in industrial chemistry are traced through three eras: (1) a pre-World War II period of free expansion; (2) a post-war period when good products impacted all sectors, emphasis was on market exploitation, and the entry-level costs of research and development increased significantly; and (3) the present period of resource supply and husbandry that began during the 1973 oil embargo. Attention has since been focused on resource depletion, the substitution of materials and energy sources, and market limits. This will be associated with a decoupling of technology development and economic growth, with chemistry's role more clearly defined and mission-oriented. A fourth period of science push may develop in the next century. Chemical opportunities for the present period are in the areas of economy and efficiency, material and fuel substitutions, the relationship of multinational companies with developing countries, and a general partnership of chemists with all levels of society.

33214 **Industrial minerals and their prospects in north western Kutch, Gujarat.** Banerjee, B.; Majumdar, S.K.; Mukherjee, S.N.;

Moitra, A.K.; Mitra, B. (Cent Fuel Res Inst, Dhanbad, India). *J. Mines, Met. Fuels;* **25**: No. 6, 171-176(Jun 1977).

The northwestern part of the Kutch district of Gujarat is a potential source of many minerals, viz. limestone, clay, bauxite, siderite, gypsum etc. Yet the industrial development has not taken place mainly due to the acute shortage of power. Exploration and development of the lignite resources of this region may, however, solve this power crisis and thus increase the viability of industrial development of the locally available minerals. For instance, limestone can be used in the cement industry, clay deposits in the ceramics industry, red ochre deposits in the dye and pigment industry, siderite for hydrogen production and gypsum for calcium sulphide production. This paper deals primarily with the evaluation studies of the mineral resources occurring in Panandhro and its adjoining area. 4 refs.

33215 Application of optimal stochastic control theory to long-range planning in resource management: the value of wheat-supply information. Sand, F. (ECON, Inc., Princeton, NJ). pp 685-690 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

There are an increasing number of economic problems that have come under the powerful mathematial influence of stochastic control theory in recent years. A few have explicitly embodied stochastic elements to address the issue of uncertainty concerning future supply or demand, and its effect on long-range planning. The ECON, Inc. work for NASA's LANDSAT program on the value of remote sensing crop information led to the formulation of a stochastic optimal control problem. This paper discusses the formulation of a group of stochastic optimal control problems relatd to the economic evaluation of improved wheat-production forecasts. Many of the techniques, if not all, are applicable to quite-different resource problems.

33216 Modeling the benefits to world agriculture from remote sensing. Kochanowski, P. (Indiana Univ., South Bend). pp 691-695 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

Remote sensing of agricultural land permits crop classification and mensuration which can lead to improved forecasts of production. This technique is particularly important for nations that do not already have an accurate agricultural reporting system. Better forecasts have important economic effects. International grain traders can make better decisions about when to store, buy, and sell. Farmers can make better planting decisions by taking advantage of production estimates for areas out of phase with their own agricultural calendar. World economic benefits will accrue to both buyers and sellers because of increased food supply and price stabilization. This paper reviews two world modeling efforts used to empirically establish the above scenario. Dollar estimates, their implications for the United States and the rest of the world, and inherent modeling difficulties are described.

RESEARCH AND DEVELOPMENT

REFER ALSO TO CITATION(S) 33213, 33311, 33312, 33314

33217 (CONF-771037—, pp 1-3) **Future direction of transportation research and development in the Department of Energy.** Esposito, V.J. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A brief overview of the organizational structure of the U.S. Department of Energy is given, and the general functions under the Assistant Secretary for Conservation and Solar Applications are outlined. (PMA)

33218 (CONF-771037—, pp 5) **NASA Lewis Research Center Role in transportation programs for the Department of Energy.** Lubarsky, B. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A very brief review is given of the history of NASA to place in perspective the role of NASA in DOE activities.

33219 (CONF-771037—, pp 5-8) **DOE/NASA procurement policy.** Brown, C.; Cumesty, E. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Money is transferred from DOE in Washington to NASA for source selection, procurement, and contract administration. In general, NASA gets its guidance from DOE regarding procurement policies. The main objective of DOE is to identify and develop the technology needed to conserve energy and to make sure energy sources and appropriate equipment are available to the population and industry as needed. The energy crisis adds the other element of "time" because of reported depletion in petroleum energy sources. A brief outline is given of the general procurement procedures.

NUCLEAR ENERGY

REFER ALSO TO CITATION(S) 32812, 32813, 33137, 33138, 33264

33220 Gloomy future for energy: can we afford nuclear energy. Talmet, L.; Svensson, B. (Stockholm Univ. (Sweden)). *Tek. Tidskr.;* **107**: No. 16, 28, 31, 34(21 Oct 1977). (In Swedish).

Should Sweden continue in the nuclear club or instead look for alternative sources of energy. The answer to this question is perhaps that nuclear energy will become too expensive. This, at least, is indicated by the rapid cost increases in the whole nuclear-fuel cycle in recent years.

33221 Federal Republic of Germany: ordinance concerning the procedure for licensing installations pursuant to Section 7 of the Atomic Energy Act (Nuclear Installations Ordinance). *Nucl. Law Bull., Suppl.;* No. 19, 3-14(May 1977). (In English, French).

The Ordinance which deals with the licensing procedure for nuclear installations came into force on 1 March 1977, thus repealing the previous Nuclear Installations Ordinance of 29 October 1970. It was made by the federal minister competent for nuclear safety and radiation protection, namely the Minister of the Interior, with the consent of the Federal Council, in accordance with the provisions of the Atomic Energy Act and the Act on Protection against Nuisances. The ordinance contains detailed provisions on how licensing applications should be filed, on participation in the procedure by third parties, and on notification of decisions by the competent authorities. As compared with previous regulations, it should be noted that provisions on organisation of public hearings to discuss objections to projects have been expanded considerably.

33222 To assure public safety in a nuclear age we must reform the AECB. Doern, C.B. (Carleton Univ., Ottawa, Ontario (Canada)). *Sci. Forum;* **10**: No. 2, 3-5(Apr 1977).

The author argues that the Canadian AECB should clearly be seen to be independent of the nuclear industry and of governmental interference. He considers the board to be too small, as well as understaffed, and would expand it to seven members, three of them full-time. A larger staff would enable the board to serve as a reliable source of independent public information on nuclear regulatory issues. It is suggested that the government should publish policy directives for the AECB annually. Another suggestion is that some research should be contracted out to the National Research Council, instead of to the nuclear industry. The author wishes to accelerate changes that the AECB itself has set in motion.

33223 How Canada's and India's nuclear roles have been sadly misrepresented. Bindon, G. (Concordia Univ., Montreal, Quebec (Canada)); Mukerji, S. (Montreal Univ., Quebec (Canada)). *Sci. Forum;* **10**: No. 1, 3-7(Feb 1977).

The authors are concerned to remove misunderstandings about the termination of nuclear cooperation between Canada and India following India's explosion of a nuclear device in 1974. The history of the cooperation between the two countries, leading to the construction of the Rajasthan-1 reactor, is recounted. It is suggested that India had long intended to explode a nuclear device, consistent with its refusal to sign the nonproliferation treaty; surprise was therefore unwarranted. The value of the Rajasthan contract to the Canadian nuclear industry is emphasized, on the grounds that it came at a crucial time, just after Douglas Point had reached full power in 1962. The authors seem to believe that Canadian industry will suffer in that it will be more difficult to achieve agreements with developing countries in the future. This is made the occasion for some general criticism of the Canadian nuclear programme, but not of the Indian, which is held to be more diversified, and therefore able to develop supposedly practical and better alternatives to nuclear energy.

33224 Is uranium a possible alternative to meet the world's energy shortfall. Birman, J. (ed.). Perth, Australia; Extension Service, The University of Western Australia (1977). 280p.

A broad overview of worldwide energy resources and probable shortages, nuclear power economics, fuel cycle economics, uranium mining and processing, and all the hazards and advantages associated with nuclear power is given. A comparison is made with

the current situation and future energy prospects in Western Australia.

33225 Nuclear power planning study for Hong Kong. Vienna; IAEA (1977). 189p.

The major objective of the study is to determine the optimal timing and size of nuclear power plants that could be built in Hong Kong during the period 1981-2000. The study could also be considered as the background information on energy resources of the country. Included is general information on economics, geographic and demographic features of Hong Kong, development of the electric power system, forecasting of energy demand, methodology and basis for evaluation, and results of analysis. Technical, economic, and financial aspects of the energy demand are discussed in 9 appendixes.

33226 Nuclear power and weapons proliferation. Greenwood, T.; Rathjens, G.W.; Ruina, J. London; International Institute for Strategic Studies (1977). 51p.

The subject is covered in sections, entitled: nuclear weapons technology; the nuclear fuel cycle; nuclear power technology (comparative analysis of nuclear fuel cycles, chemical reprocessing of spent fuel, uranium enrichment); controlling the diffusion of nuclear technology.

33227 Discriminant analysis of characteristics determining acceptance or rejection of nuclear power. Holsapple, C.W.; Whinston, A.B. (Purdue Univ., West Lafayette, IN). pp 867-870 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

This study utilizes the linear discriminant model to analyze demographic and attitudinal data concerning the construction of a nuclear power facility at the Bailly site in northern Indiana. The objective is to ascertain the extent to which various respondent characteristics are useful in distinguishing among respondent attitudes (opposed, in favor, unsure) toward the Bailly project. Examination of reduced space characteristics leads the authors to postulate an interpretation of its two dimensions as respondent uncertainty and respondent resistance. The largest contributor (positive) to uncertainty was found to be a divorced or separated marital status; the greatest contributer (negative) to resistance was found to be home ownership. Both of these respondent characteristics were significant in the univariate sense. A particularly striking trend was the reliance of the opposed group upon electronic media as the source of most local news, whereas the other two groups tended to rely most heavily on newspapers.

33228 Atomic Energy Control Board. An evaluation of regulatory and administrative processes and procedures. Doern, G.B. Ottawa, Canada; Law Reform Commission of Canada (1976). 85p.

This study describes and assesses the regulatory and administrative processes and procedures of the Atomic Energy Control Board, the AECB. The Atomic Energy Control Act authorized the AECB to control atomic energy materials and equipment in the national interest and to participate in measures for the international control of atomic energy. The AECB is authorized to make regulations to control atomic energy materials and equipment and to make grants in support of atomic energy research.

WASTE HEAT UTILIZATION

REFER ALSO TO CITATION(S) 33306, 33307, 33308, 34026

33229 Cogeneration options for industrial power. Illingworth, L. *Energy Int.;* **15**: No. 2, 21-24(Feb 1978).

Selection of the most effective turbine to use in conjunction with co-generation depends largely on the amount of process steam required for plant operations relative to the power demand. Back-pressure and extraction-condensing machines are the two main types used industrially. Back-pressure turbines in parallel with public power supply are determined to be the most efficient as well as being reliable, simple to operate, and of low initial cost. Extraction-condensing turbines are appropriate for factories with widely fluctuating steam demands of when power requirements are substantially higher than steam requirements. The relative merits and applications for these turbines are described and recommendations for selection are made.

CONSERVATION

REFER ALSO TO CITATION(S) 33272, 33273

33230 (DOE/CS—0035) Voluntary industrial energy conservation. Progress report 5. (Department of Energy, Washington, D.C. (USA). Office of Business Assistance Programs). Mar 1978. 140p. Dep. NTIS, PC A07/MF A01.

This publication is the fifth in a series (with two additional updating issues) of reports showing progress in energy conservation made by industry. The report contains information on industry's achievements in conserving energy and provides new data on energy use and savings for the full year 1976. Also listed are those industries that are developing industrial-energy-efficiency reporting systems, and the industries that have been contacted by the Department of Commerce regarding participation in the Voluntary Industrial Energy Conservation Program. Fifty industry groups provided data for this report. The following groups submitted information for the first time: Aerospace Industries Association of America, American Boiler Manufacturers Association, Building Owners and Managers Association International, Commercial Refrigerator Manufacturers Association, Construction Industry Manufacturers Association, Copper and Brass Fabricators Council, Farm and Industrial Equipment Institute, Ferroalloys Association, General Aviation Manufacturers Association, National Soft Drink Association, and the U.S. Brewers Association.

33231 (DOE/CS—0036) Voluntary industrial energy conservation. An update of progress report 5. (Department of Energy, Washington, D.C. (USA). Office of Business Assistance Programs). Nov 1977. 21p. Dep. NTIS, PC A02/MF A01.

This report represents a supplement to Progress Report 5 (July 1977). Energy-efficiency improvement data are provided for those industry groups collecting data on a quarterly basis. Specifically, it contains nine reports reflecting results for the first quarter of 1977 for: American Die Casting Institute; American Foundrymen's Society; Brick Institute of America; Corn Refiners Association; General Aviation Manufacturers Association; Gypsum Association; Metal Treating Institute; Motor Vehicle Manufacturers Association; and Tile Council of America. Data have been compiled previously for 41 industry groups. (MCW)

33232 (TID—28277) Illinois Home Energy Savers' Program. (Illinois Dept. of Business and Economic Development, Springfield (USA). Div. of Energy). 1977. 256p. TIC.

Portions of document are illegible.

The Energy Saver's Program (HESP) is being tested in 11 Illinois counties to provide impetus for people to weatherize their homes. The 11 test counties include Boone, Henry, Kane, McLean, Peoria, Rock Island, Sangamon, Tazewell, Will, Winnebago, and Woodford. Included in the home energy audit is a check of thermostats, windows, doors, attic, sidewalls, basement, and crawl spaces for inadequate insulation. The HESP kickoff occurred on June 15, 1977 with a press conference and an energy audit of the governor's mansion. Homeowners (350,000) in the 11 countries received an HESP questionnarie and an application for a workbook. The quiz and a copy of the workbook are included in this report. Promotional programs through the media, posters, display booths, and other forms of communications were used to make the public aware of the need for energy conservation. Results are evaluated. (MCW)

33233 How DoE evaluates technologies for support in industrial efficiency. *Energy Res. Rep.;* **4**: No. 4, 2-5(20 Feb 1978).

An interview with Douglas G. Harvey, continued from the Feb. 6 issue, covers DOE evaluation of proposed energy conservation activities and technologies. Criteria for DOE acceptance include a 15 percent after-tax return on investment and the potential for market penetration as determined by a formula using Standard Industrial Classification codes and modeling of risks. Success of the formula is illustrated, but more demonstration is needed to verify the new technique's usefulness. The office testifies on proposed legislation when requested to do so, but prefers a more active role. The concept of policies to establish certified energy auditors is seen as a way to increase awareness and documentation of energy consumption.

33234 Energy conservation in buildings. Brundrett, G.W.; Leach, S.J.; Parkinson, M.J.; Pickup, G.A.; Rees, N.T. *Coal Energy Q.;* No. 15, 14-28(Win 1977).

The second of a two-part series on energy conservation in buildings identifies the four factors to be considered for heating systems as proper sizing, operation efficiency over the full load range, design and control, and the owner's operating methods. It is an amalgam of four papers from The World Energy Conference (Istanbul, 1978) that dealt with the impact that higher insulation standards and lower ventilating levels have on the above factors. The discussion covers the ratio of systems efficiency to boiler output and performance testing of heating appliances, solid fuel heating, heat pumps, solar systems, and heat reclamation systems. Performance data are compared and the conclusion reached that high quality insulated houses built with solar, heat pump, or heat-reclaim systems will take only a third or less primary energy as houses with conventional systems. It is argued that building designs should be based on

retaining fuel options rather than projections of fuel costs. 4 references.

33235 (DOE-tr—46) **Agency for Energy Savings.** 1976. Translation of French report. 52p. Dep. NTIS, PC A04/MF A01.

The French government established in late 1973 an energy policy aimed at reducing its dependence and limiting the cost of energy supplies. Specifically, the creation on Nov. 29, 1974, of an Agency for Energy Savings was finalized. The actions undertaken by this agency over the past year are analyzed in the first part of this report and a description of the entire system as currently set up is given. The second part of the report describes the financial and human resources that the agency can call upon in the accomplishment of its task. Part three analyzes the results obtained in each sector. Information on demonstration operations: situation as of 12/31/76; investment subsidies: situation as of 12/31/76; energy savings accords by sector; consumption decrease goal; Law No. 74.908 of October 29, 1974 and implementing regulations; documents published and distributed by the Agency for Energy Savings; and corrected energy balance sheets of temperature variations is included in the appendices. (MCW)

SUPPLY, DEMAND, AND FORECASTING

REFER ALSO TO CITATION(S) 33224, 33294, 34026

33236 Legal problems in connection with long-term energy-supply contracts. Futter, W. *Betr.-Berat.;* **31**: No. 28, 1295-1298(Oct 1976). (In German).

Condition under which the last customer in a line can terminate long-term energy-supply contracts, e.g. natural gas or heat supply contracts, are first investigated. Then, legal problems in connection with the price setting of price-adaptation clauses in energy supply contracts are dealt with. Discussed are various modalities of these clauses, which range from a complete price automatism in the sense of a correlation clause up to a supply under reservations with adaptation negotiations between the parties.

33237 Plans and conceptions of the Federal government concerning the future energy supply. Questions concerning energy policies ought to be discussed as widely as possible. Hauff, V. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). *Buerger Staat;* **26**: No. 1, 55-57(Mar 1976). (In German).

The author, parliamentary undersecretary in the Federal Ministry for Research and Technology, deals in his article with the main targets of the government's energy program Among the subjects discussed are: reducing the dependence on petroleum from, at present, 55% to 44% in 1985; stabilizing coal haulage and the use of coal for electricity supply; increased utilization of nuclear energy as the new energy source for electricity supply (its share is to rise from its present 5% to 45% in 1985; intensified use of natural gas through new import agreements as a medium-term interim solution.

POLICY, LEGISLATION, AND REGULATION

REFER ALSO TO CITATION(S) 32616, 32705, 32706, 32711, 32746, 32747, 32748, 32749, 32750, 32751, 33193, 33211, 33236, 33252, 33729, 33730

33238 (CONF-7705111—, pp 13p, Paper 1, Set No. 1) **Energy picture today.** McKetta, J.J.; Schoch, E.P. (Univ. of Texas, Austin). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

The author is critical of the U.S. Congress for not having developed a reasonable energy policy in the 4 years which have elapsed since 1973. In fact, many of the new governmental regulations resulting from the efforts of politicians, environmentalists and conservationists have decreased the supply of domestic energy. While one branch of the government is ordering more plants to use coal, other branches have taken essentially contradictory actions (strip mining legislation, moratorium on leasing federal coal lands, too strict clean air rules, etc.). Nuclear energy problems are discussed briefly. The author gives recommendations for a national energy policy which will require great personal sacrifices and billions of dollars, but is necessary in view of the situation. Unless effective action is taken, the author foresees a serious energy shortage by 1985. (LTN)

33239 Iran's security in the 1980's. Chubin, S. (International Inst. for Strategic Studies, London). *Int. Secur.;* **2**: No. 3, 51-80(Win 1978).

Iran's security assurance, in view of its position as a neutral nation in close proximity to vast petroleum deposits and the Soviet Union, is perceived to be dependent on prudent defense planning based on geopolitical fatalism. Iran's impact on relations between the superpowers is seen to be marginal, but a more active regional role is possible. A review of the external pressures on the country is followed by an assessment of Iranian weapons capability and procurement patterns during the recent modernization and upgrading of the armed forces. Military missions include border, air space, and shipping defense and limited sea denial. The politics of weapons procurement has led Iran to diversify its arms supplies whenever possible. Studies indicate that economic development need not be precluded by military expenditures and may lead to increased domestic production and maintenance facilities. The implications of arms control strategies are outlined from the Iranian, regional, and global points of view.

33240 Die Energiepolitik der Bundesregierung von 1958 bis 1972. Zur Bedeutung der Penetration auslaendischer Oelkonzerne in die Energiewirtschaft der BRD fuer die Abhaengigkeit interner Strukturen und Entwicklungen. (Energy policies of the Federal government from 1958 until 1972. The significance of foreign oil combines penetrating the energy economy of the FRG with regard to internal structures and developments). Horn, M. Berlin, Germany, F.R.; Duncker und Humblot (1977). 320p.

Thesis.

After introductory problem formulations and definitions, the following subjects are dealt with in the contribution at hand: 1) Development of the energy economy structure under the influence of foreign oil combines; 2) the importance of the development of the energy consumption in the FRG for the competitiveness of the FRG's industry and subsequent problems concerning safety policies and ecology; 3) character and scope of governmental interventions in the energy economy of the FRG.

33241 Use of unified program planning for energy policy analysis and project selection. Sage, A.P. (Univ. of Virginia, Charlottesville); Smith, T.J. pp 945-951 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P2.

This paper develops and illustrates a methodology for policy analysis and project selection based on the unified program planning concept of Hill and Warfield. A top/down approach to developing those program-planning linkages most useful for policy analysis and program selection is suggested. This adaptation of the unified program planning methodology is applied to the energy supply and demand problem in order to expose the multiple objectives and attributes as well as program interrelationships needed in policy analysis to plan for action to implement project planning and selection.

33242 Pravila bezopasnosti pri geologorazvedochnykh rabotakh. (Safety rules during geologic exploratory operations). Moscow; Nedra (1976). 222p.

Safety rules are examined in geological survey, geological prospecting, geophysical, hydrogeological, geological engineering, drilling and mine surveying operations. Safe work methods in testing solid mineral resources, using internal combustion engines, transportation, lumber procurement, and other types of operations are described. The rules are approved by the USSR State Committee for the Supervision of Industrial Safety and for Mining Inspection.

33243 Optimal energy policy planning. Hnyilicza, E. (Massachusetts Inst. of Tech., Cambridge). pp 272-275 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

A description is given of the results of a study aimed at investigating the problem of optimal growth as an optimal control problem involving the maximization of welfare subject to the constraints embodied in a long-term macroeconomic energy model. For the policy optimization experiments, it is assumed that the set of policy instruments included the rate of taxes on capital income and capital property, investment tax credits, sales taxes on consumption and investment goods and other tax rates. The performance index for the optimal control problem is defined as the present value of a discounted stream of utilities accruing to households from the consumption of energy goods, nonenergy goods, capital services and leisure. A discussion is given of the policy implications of the optimization experiments from the standpoint of long-term energy policy planning.

FOSSIL FUELS

REFER ALSO TO CITATION(S) 32705, 33238

COAL

REFER ALSO TO CITATION(S) 32613, 32617, 32623, 32624, 32691, 32703, 32704, 32706, 32711

33244 (FE/1216—4) **Assessment of low- and intermediate-Btu gasification of coal.** (National Research Council, Washington, D.C. (USA). Ad Hoc Panel on Low-Btu Gasification of Coal). Dec 1977. Contract EX-76-C-01-1216. 114p. Dep. NTIS, PC A06/MF A01.

Industrial and utility uses account for about 35 percent of the country's consumption of oil and gas. Low- and intermediate-Btu gases made from coal may be used instead of natural gas or oil in electric power generation and industrial plants. Low-Btu gas cannot be stored economically or transmitted over appreciable distances; therefore, it is anticipated that coal will be shipped to gasification plants near the point of gas consumption. Production of low-Btu gas from coal may increase energy costs by approximately 200 percent above the cost of the coal (assumed to be $1.00 per million Btu). The overall thermal efficiency of the process is estimated to be about 70 to 80 percent based on cold gas purification. The use of intermediate-Btu gas involves fewer problems than the use of low-Btu gas since the heating value of the gas is high enough to reduce flame temperature limitations and feed gas volumes. Generation of intermediate-Btu gas at a central location with distribution over distances of up to about 100 miles would mitigate the problems of coal handling and gasification at each plant location. It is estimated that the use of intermediate-Btu gas would raise fuel costs 200 to 300 percent above the cost of the coal. The thermal efficiency of the process is 65 to 70 percent based on gas purification at temperatures below 120°C. For the equivalent amount of energy, intermediate-Btu gas is estimated to cost 65 to 75 percent of the cost of pipeline gas produced from coal (assuming coal cost of $1.00 per million Btu). A number of other conclusions are listed. (LTN)

33245 **World coal trade developments.** Parker, M.J. *Coal Energy Q.;* No. 15, 10-13(Win 1977).

International coal trade is projected to double by the mid-1980's, although available coal for export may become restricted as domestic demands increase. Coking coal, which dominates world trade, is closely associated with steel-intensive activities so that demand will be shifting from developed to developing countries. Production increases to cover the world demand are needed in the U.S., Canada, and Australia. Demand for steam coal is expected to increase sharply and assume a major share of the world trade.

33246 **British Coal International.** Rhodes, H. *Coal Energy Q.;* No. 15, 29-34(Win 1977).

British Coal International was formed in 1977 to promote and co-ordinate the overseas activities of the National Coal Board and other coal-oriented organizations. The companies comprising the group and their mission are outlined and the point made that the combined expertise will make an overseas total mining project feasible. Potential customers can also request only selected services, such as exploration, mining technology, and investment. Examples are given to illustrate how the participating companies can combine and interact to solve specific problems. British exports are seen as a way to provide access and secure markets after a coal reserve is located and before production begins.

33247 **Energy. Needs and resources.** Odell, P. (Erasmus Universiteit, Rotterdam (Netherlands)). Basingstoke; Macmillan Education (1977). 34p.

The size of the likely energy resources is evaluated, and the rate of increase of demand. Particular attention is paid to the future availability of oil, and natural gas, but coal is also considered in detail. It is concluded that massive development of alternative sources of energy will not be required until the second quarter of the twenty-first century at the earliest. Research should continue into fusion and solar energy as the long-term alternatives to conventional energy sources. In the meantime, it is stated, we can severely restrict the degree to which fission nuclear power is developed.

PETROLEUM

REFER ALSO TO CITATION(S) 32712, 32743, 32744, 32745, 32746, 32747, 32748, 32749, 32750, 32751, 33247

33248 (DOE/ERA—0001) **Preliminary report. Preliminary findings and views concerning the exemption of aviation gasoline from the Mandatory Petroleum Allocation and Price Regulations.** (Department of Energy, Washington, D.C. (USA). Energy Information Administration). Jan 1978. 84p. Dep. NTIS, PC A05/MF A01.

Preliminary findings indicate that: the fuel is not in short supply; exemption will not have an adverse impact on supply of any other petroleum product subject to the Emergency Petroleum allocation Act of 1973; competition and market force are adequate; exemption will not result in inequitable prices; and exemption will not have adverse state or regional impacts or any other adverse impacts. Chapter II provides background information on the use, production, and distribution of aviation gasoline. Chapter III analyzes the historical interaction of supply, demand, and price, and explores the market structure for aviation gasoline during 1968 to 1976, prior to and during imposition of allocation and price controls. Chapter IV examines aviation gasoline supply, demand, price, and market structure impacts of exempting aviation gasoline from controls. In Chapter V, the potential economic impacts of exemption are evaluated. Chapter VI provides a final summary of the DOE's findings and views in support of its preliminary judgment that aviation gasoline should be exempted from allocation and price regulations. (MCW)

33249 (DOE/ERA—0002) **Preliminary report. Preliminary findings and views concerning the exemption of kerojet fuels from the Mandatory Petroleum Allocation and Price Regulations.** (Department of Energy, Washington, D.C. (USA). Energy Information Administration). Jan 1978. 109p. Dep. NTIS, PC A06/MF A01.

Preliminary findings indicate the following: kerojet fuel is not in short supply; it will not adversely impact on the supply of other petroleum products subject to the Emergency Petroleum Allocation Act; competition and market forces are adequate; and it will not result in inequitable prices for kerojet or other products. Chapter II provides background information on the use, production, and distribution of kerojet. Chapter III analyzes the historical interaction of supply, demand, and price, and explores the market structure for kerojet during 1968 to 1976, prior to and during imposition of allocation and price controls. Chapter IV examines the effect upon kerojet supply, demand, price, and market structure of exempting kerojet from controls and indicates the benefits to be derived from such exemption. In Chapter V, the potential economic impacts of exemption are evaluated. Chapter VI provides a final summary of the DOE's findings and views in support of its preliminary judgment that kerojet should be exempted from allocation and price regulations. (MCW)

33250 (UCRL—52345) **New developments affecting the supply of oil to the Free World.** Borg, I.Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1977. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The objective of this report is to update an earlier assessment of future world oil supply and demand. Recent exploration in Mexico and the North Sea indicates that these areas will contribute more to world supplies than anticipated; in the U.S., delayed leasing schedules and unsuccessful exploration in many areas on the Outer Continental Shelf suggest a production potential below previous expectations; the fact that more and more OPEC nations are setting arbitrary production limits will also affect the future oil supply adversely; and early estimates of future Russian and Chinese exports seem now to have been overly optimistic. In view of these and other new developments that affect worldwide demand for oil, world demand will probably exceed the supply by about 7 million bbl/day in 1990. Seasonal demands and growing markets for specific types of crude oil will create local shortages before that time. Thus, increasing prices and increasing competition for available supplies seem inevitable until syncrudes and other exotic energy sources become available in quantity.

NATURAL GAS

REFER ALSO TO CITATION(S) 32745, 32746, 32747, 32748, 32749, 32750, 32751, 32760, 32761, 32762, 32765, 32767, 33247

OIL SHALES AND TAR SANDS

33251 **What price oil shales.** Gallois, R. (Inst. of Geological Sciences, London). *New Sci.;* 77: No. 1091, 490-493(23 Feb 1978).

Oil shale reserves, estimated at over 600 times greater than proven world petroleum reserves, have not been exploited extensively because of the high costs and technical problems involved. Present technology makes oil shale development non-competitive because of the high temperatures needed for retorting, the environmental impacts from large quantities of spent shale, the presence of carcinogens in the waste, and the large amounts of cooling water needed. The nature and formation of oil shales is described, followed by an overview of present research and development and an evaluation of present techniques. Private industry has requested government funding before it will continue with demonstration programs, but policy debates still pit the high cost of loan guarantees against the promotion of fuel conservation. Oil-shale industries are operating in the Soviet Union and China, although their share of each country's total energy is small. Brazil and the U.S. have the largest

potential deposits, but immediate efforts to exploit oil shales will probably occur in the Third World countries first.

ELECTRIC POWER

REFER ALSO TO CITATION(S) 32996, 33210

33252 (FPC-A—125) **Federal Power Act.** (Federal Power Commission, Washington, D.C. (USA)). 1 Apr 1975. 387p. GPO.

The Federal Power Act, originally enacted as the Federal Water Power Act, approved June 10, 1920, is presented. On March 3, 1921, it was amended to exclude therefrom any authority to license water power projects in national parks or national monuments. The Commission was reorganized as an independent Commission under the Act approved June 23, 1930. By Title II of the Public Utility Act of 1935, approved August 26, 1935, the original Federal Water Power Act was made Part I of the "Federal Power Act" and Parts II and III were added to that act. Part II vests in the Commission jurisdiction over the interstate transmission of electric energy and public utility companies engaged therein. Part III relates to such companies and to licensees and carries the administrative and procedural provisions of the Federal Power Act. An extensive appendix in this publication presents numerous statutes related to the Federal Power Act and the jurisdiction of the Federal Power Commission.

33253 **Urban model application to electric-demand forecasting.** Willis, H.L. (Houston Lighting and Power Co., TX). pp 5-10 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

A small-area electric-demand forecasting model functions by forecasting small area land use as an intermediate step. The land-use forecast model includes a simplified urban model of the Lowry type. This model works on a data base of land-use classification statistics rather than the more-typical population and employment data. The model has proven satisfactory for the types of problems it was designed to handle.

33254 **Land-use information for small-area load forecasting.** Wilreker, V.F. (Westinghouse Electric Corp., Pittsburgh). pp 11-15 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

The author presents an interesting data source for determining small-area electric load (e.g., LANDSAT interpreted land use). To test the effectiveness of using LANDSAT to forecast load, two land-use sources are used—map-interpreted land use and LANDSAT-interpreted land use. The results of using either data source is shown to be essentially the same. The forecast is accomplished by first grouping similar small areas into clusters, and then developing a linear forecast model for each cluster.

33255 **Evaluation of electric utility load-management strategies.** Blair, P.D.; Weygandt, C.N.; Eisenberg, L. (Univ. of Pennsylvania, Philadelphia). pp 37-43 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

This paper reviews current work at the University of Pennsylvania, the purpose of which is to examine the potential for reducing electric-utility peak loads through residential load management. Typical load curves from major residential electric appliances are compiled from various sources along with information concerning saturation of these appliances. A total residential load curve is then assembled from these appliance components and compared against measured residential curves. Based upon an examination of these appliancee load profiles and their corresponding projections into the next decade, any appliances that appear to be likely candidates for load management are identified.

33256 **Dynamic interactive model of electrical utility and community.** Chang, S.S.L.; Ganesan, A. (State Univ. of New York, Stony Brook). pp 57-61 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

The paper presents a dynamic electrical supply and demand model with emphasis on supply-demand coupling through a price schedule. It gives a systematic way of representing the following factors: exogenous factors (economy and major technological developments); control or management decision factors; community growth factors; induced technological developments, such as energy-saving appliances, dynamical or time-dependent effects; trends, seasonal variations, daily load profile, weather dependent variations; and price and availability variations of energy resources.

33257 **Power in Ontario.** *Mod. Power Eng.;* **70**: No. 12, 37-52(Dec 1976).

Three sections of the article, on Bruce A Nuclear Generating Station, Pickering B, and Bruce Heavy Water Plant, have been abstracted separately. For economic reasons, Ontario Hydro has postponed some future generating stations in the face of rapidly growing demand for electricity. Due to an unlucky combination of circumstances, particlarly the unavailability of four units at Nanticoke coal-fired station, Ontario Hydro has had to import electricity during the winter of 1976-1977. These and other economic aspects, future supplies of fuel, Lennox oil-fired station, transmission lines, substations, and possible district heating from Nanticoke, are discussed.

ELECTRIC POWER GENERATION

REFER ALSO TO CITATION(S) 33205, 33229

33258 (HCP/B60792—03) **Study of benefits of improved power-plant reliability and productivity. Phase 3 report. National analysis.** (General Electric Co., Washington, D.C. (USA). Center for Energy Systems). 30 Dec 1977. Contract EM-76-C-01-8713. 74p. Dep. NTIS, PC A04/MF A01.

In March 1975, a Federal Interagency Task Group published a report entitled "A Report on Improving the Productivity of Electric Power Plants." Further analysis of the benefits of improved power plant reliability was recommended, resulting in this three-phase contract. The objective of the first phase was to describe the role played by power plant productivity in electric utility planning. The second phase was an in-depth study of the benefits of improving coal and nuclear power plants on two specific utility power systems, New England Power Pool, and Detroit Edison. The third phase of this contract is the extension of the second phase to an assessment of the potential benefits to the entire nation. The same methodology employed in the in-depth analysis of Phase II is applied, but on a regional basis. This study seeks to assess the potential national benefits of improving by 5% both the forced outage and planned outage rates of base-load coal and nuclear units. This 5% improvement was postulated to begin in 1978 and would be achieved by 1985. Currently, the forced and planned outage rates of base-load coal and nuclear units are in the range of 15%. Thus, the 5% improvement would decrease these outage rates to approximately 10%. In performing these studies, neither the costs of implementing the productivity improvements nor the feasibility of attaining the improvements were included. The results reported in this study are the potential benefits and do not include any capital costs and O and M costs which may be required to improve power plant productivity. Chapter 2 presents the study parameters, methodology, and procedure, Chapter 3 regional results including potential oil and natural gas savings and potential economic savings, and Chapter 4 aggregate national results.

33259 **Net energy output of growing power systems.** Koenne, W. (Oesterreichische Elektrizitaetswirtschafts A.G., Vienna). *Oesterr. Z. Elektrizitaetswirtsch.;* **30**: No. 9, 396-399(Sep 1977). (In German).

By means of a computer model, the relationships between energy consumption and energy output during the construction and operation of individual power stations and (growing) power systems are investigated. The model of a general nature and can be used for different types of power stations and even mixed systems. A certain construction scheme is presented as a practical example. It shows that statements, regarding a negative energy ratio in the case of nuclear power stations lack a concrete basis.

ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

REFER ALSO TO CITATION(S) 32984

33260 **Application of the EMPIRIC urban model to small-area load forecasting.** Fine, F. (F.M. Fine and Associates, Albuquerque, NM); Enloe, T.H.; Johnson, T.M. pp 1-4 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

This paper describes an approach to small-area electrical-load forecasting for planning distribution facilities that utilize an urban model. Urban models, in general, and the EMPIRIC activity allocation model, in particular, are discussed. The development of an

EMPIRIC model for small-area load forecasting and the results of a trial run are discussed.

CONSUMPTION AND UTILIZATION

REFER ALSO TO CITATION(S) 33196, 33231, 33233, 33280, 33282, 33382

33261 (BNL—50713) **Energy use in Japan and the United States.** Doernberg, A. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1977. Contract EY-76-C-02-0016. 73p. Dep. NTIS, PC A04/MF A01.

This comparative study was undertaken to explain in part the per capita differential between the two countries. In the introduction, the ratios of energy per capita and energy per dollar of Gross Domestic Product (GDP) are presented. The exchange rates utilized to convert GDP to a common currency are discussed in detail. Brief sections on the energy supply and electric generation situation in Japan are included for background information, followed by the body of the report devoted to the energy consumption sectors. The industrial sector merits most attention because Japan's industrial capacity is second only to that of the U.S. among industrialized nations, and it is here where an intercountry comparison can reveal possibilities of technology transfer. First, a gross energy efficiency indicator for all industry (measured as industrial energy use per dollar of GDP originating in industry) is established. This is followed by detailed presentations of specific energy inputs (per ton of product) for four energy-intensive industries: iron and steel, aluminium, cement, and pulp and paper. Sections on transportation, residential, and commercial energy use reveal large differences in consumption largely due to what is labeled "standard of living" (housing size, automobile ownership, selection of transportation modes). Finally, the conclusions underscore the usefulness of intercountry comparisons for industrial processes and delineate the limitations of such studies with respect to personal use of energy. Among the group of industrialized nations, Japan and the U.S. are probably the extreme case in illustrating these limitations.

33262 **Comparison of the fossil fuel energy requirements for solar, natural gas, and electrical water-heating systems.** Zucchetto, J. (Univ. of Stockholm); Brown, S. *Resour. Recovery Conserv.;* **2**: No. 4, 283-300(Nov 1977).

A method is presented which can be used to estimate all of the energy inputs required to produce a given energy output for any kind of system. These energy costs include not only direct fuel consumption but the energy required to provide goods and services for a system plus environmental considerations. In particular, an analysis is conducted to compare the energy consumption of family-size electrical, natural gas, and solar water heaters. The design of the solar water heater was based on requirements for the region of Miami, Florida. It was found that the fossil-fuel energy required to produce a Joule of heat output was significantly less for solar water heaters. Depending on the assumptions, solar water heaters use anywhere from $1/14$ to $1/7$ as much energy as a comparable electrical water heater and from $1/4$ to $1/2$ as much energy as a natural gas water heater. These values indicate significant energy conservation possibilities. The potential energy savings in Florida if all single-family homes were equipped with solar water heaters would amount to approximately 4.8×10^7 m^3/year of natural gas and 1.5×10^6 m^3 (9.5×10^6 barrels) of oil per year, comparing the efficiencies of existing water-heating systems to a solar system designed for a family of four. Calculations for different latitudes in the United States indicate that solar water heaters use less energy than comparable gas or electric systems, with the exception of Seattle, Wash. for which a gas system could provide approximately 13 percent more heat per unit of energy cost.

33263 **Transportation and development in an entropy context.** Drew, D.R. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 143-146 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Development is placed in a systems perspective, viewed both as a process and as a state. The process is the set of changes by which society controls its environment. The desired state of development, the goal, is one of minimum entropy. Classical entropy, entropy and ecology, and entropy and society are reviewed briefly. Both entropy-oriented transportation demand and entropy-oriented transportation supply models are described and their implications with respect to development discussed.

UNCONVENTIONAL SOURCES AND POWER GENERATION

33264 **New Zealand backs down from alternative energy search.** Scott, W.E. *Energy Int.;* **15**: No. 2, 28-30(Feb 1978).

A government-appointed committee decided, after investigating alternative energy sources and techniques available in New Zealand, that a proposed 1200-MW nuclear plant will be less harmful to the environment if it is properly constructed and controlled and if a way is found to recover heat. Among the alternatives studied were wind power, tidal and wave systems, solar energy, biomass, and sewage-derived methane. The committee compared equipment and land requirements, environmental effects, efficiency, and technology status before deciding that one of the alternative options has progressed to the degree of commercial application that is available with a nuclear power plant. (DCK)

SOLAR

REFER ALSO TO CITATION(S) 32878, 32896, 32905, 32918, 32952, 33987

OTHER

REFER ALSO TO CITATION(S) 32875, 32891

ENERGY CONVERSION

MHD GENERATORS

33265 (CONF-771102—20) **Prospects for open-cycle MHD plants.** Petrick, M.; Redman, W.C. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 27p. Dep. NTIS, PC A03/MF A01.

From 20. annual AICHE meeting; New York, NY, USA (13 Nov 1977).

The current status of the pertinent technology is described. Technical problems to be solved and economic promise vis-a-vis other advanced systems for electrical power generation are assessed. The bases for a reduced environmental impact are explained. Ongoing programs for the development of coal-fired plants are reviewed.

DESIGN AND DEVELOPMENT

33266 **Explosive-type coaxial MHD-generator.** Burenin, Yu.A.; Shvetsov, G.A. (Inst. of Hydrodynamics, Novosibirsk, USSR). *Fiz. Goreniya Vzryva;* **13**: No. 1, 130-132(1977). (In Russian).

A numerical analysis is made of the energy characteristics of three modes of operation of an explosive-type coaxial generator. The ranges of the initial parameters close to unity are determined for obtaining the efficiency coefficient of converting the energy of a moving piston into electromagnetic energy. The required energy values are also determined.

PERFORMANCE AND TESTING

REFER ALSO TO CITATION(S) 34285

FUEL CELLS

REFER ALSO TO CITATION(S) 33761

33267 (CONF-770664—(Absts.)) **National fuel cell seminar. Program and abstracts.** (Dynatrend, Inc., Arlington, Va. (USA)). 1977. 124p. Dep. NTIS, PC A06/MF A01.

From National fuel cell seminar; Boston, MA, USA (21 Jun 1977).

Abstracts of 40 papers are presented. Topics include fuel cell systems, phosphoric acid fuel cells, molten carbonate fuel cells, solid fuel and solid electrolyte fuel cells, low temperature fuel cells, and fuel utilization. (WHK)

33268 (CONF-7606156—(Absts.)) **ERDA/EPRI fuel cell seminar. Program and abstracts.** (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Conservation Research and Technology; Electric Power Research Inst., Palo Alto, Calif. (USA)). Jun 1976. 117p. Dep. NTIS, PC A06/MF A01.

From ERDA/EPRI fuel cell seminar; Palo Alto, CA, USA (29 Jun 1976).

Abstracts or summaries of the 34 papers given are included. The overall research and development fuel cell programs of EPRI, US ERDA, and the Army are reviewed. Topics of the six sessions include (1) first generation fuel cell systems, (2) fuel cell systems, (3) molten carbonate fuel cells, (4) electrocatalysis research, (5) solid oxide and organic electrolyte fuel cells, and (6) fuels and fuel processing. (WHK)

MATERIALS, COMPONENTS, AND AUXILIARIES

33269 Negative aluminium electrode for biogalvanic metal-oxygen cells. Weidlich, E. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,336,119/C/. 24 Mar 1977. 4p. (In German).

The invention deals with an aluminium anode for biogalvanic metal-oxygen cells. The object of the invention is to further improve an aluminium anode for biogalvanic metal-oxygen cells. In particular, the service life is to be increased and the Faraday degree of efficiency is to be improved, by suppressing an excessive hydrogen development. The anode is thus constructed so as to have a metal net on both sides with aluminium layers and the surfaces of the aluminium layers not facing the metal net are lapped or sand-blasted and have an eloxal layer on their boundary regions.

ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

BUILDINGS

REFER ALSO TO CITATION(S) 32988, 33234, 33261, 33262, 33688

33270 (EMD—78-2) **Evaluation of the plan to conserve energy in Federal buildings through retrofit programs.** Canfield, M. Jr. (General Accounting Office, Washington, D.C. (USA)). 22 Dec 1977. 15p. Accounting Office, Washington, DC.

Buildings consume about 39% of the total energy used by the Federal Government. Energy conservation in these facilities, therefore, is essential in any program to reduce the Government's energy use. The Department of Energy has developed a comprehensive plan to reduce energy use in existing Federal buildings through retrofit programs. However, several areas should be further developed before it is submitted to the President for final approval, including: better procedures and criteria for evaluating, selecting, and approving retrofit projects; improved funding mechanisms for energy conservation retrofit projects; improved procedures for evaluating Energy Management Systems; and better marketing and use of the retrofit handbook.

33271 How do I insulate properly. New regulations concerning the thermal insulation of buildings. Wichmann, H. *Dachdecker-Handw.;* No. 12, 832-841(1976). (In German).

The article deals with the DIN regulations concerning the thermal insulation in buildings (DIN 4108) in the 1969 version, supplementing stipulations to DIN 4108 in the 1974 version, and the supplementary sheet to DIN 4108 dated 1975. The regulations in question are illustrated by examples.

33272 (ORNL/SUB—77/13509/2) **Survey of utility load management and energy conservation projects.** (Energy Utilization Systems, Inc., Pittsburgh, Pa. (USA)). Dec 1977. Contract W-7405-ENG-26. 224p. Dep. NTIS, PC A10/MF A01.

Load management is the alteration of the real or apparent pattern of electricity use. It is particularly attractive in terms of its potential for conserving energy and capital in the production and distribution of electric power, for shifting a significant amount of the fuel base from our diminishing supply of oil and gas to more abundant coal, nuclear, and renewable resources and for stabilizing the cost of electricity. Th activities currently underway in the electric utility industry relating to electric load management through using thermal energy storage on the customer's side of the meter are described. Also included are current projects in communications and load control for load managment. Fifty-eight utility-sponsored thermal energy storage projects and forty-one communications and load control projects are summarized. In general, the summaries describe for each project the objectives and status, the type of equipment and its function and environment, and the major results. The amount of information available varies from project to project depending on its status. Many of the thermal storage programs will be seen to be in early stages of development. The reader will be brought up to date on the status of energy storage and load control projects now being conducted by U.S. electric utilities to help achieve the energy objectives of our nation.

33273 (ORO/3509—1) **Survey of utility load management and energy conservation projects.** (Energy Utilization Systems, Inc., Pittsburgh, Pa. (USA)). Jun 1977. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

The Electric Systems Division of the U.S. Energy Research and Development Administration (ERDA) and the Electric Power Research Institute (EPRI) are planning a comprehensive program of field demonstration and evaluation of customer-side energy storage technologies. As a first step we have sponsored a survey of the utility industry to identify projects that are already completed, ongoing or planned. The results of this survey are presented and include identification of supply-side storage projects, communication and control systems projects and utility activities relating to energy conservation by the customer. In the near future, an in-depth analysis and evaluation of the more significant projects will be completed to provide input for the design and implementation of a comprehensive demonstration program, building on what is alredy being done by the industry.

33274 Operational efficiencies of heating units. John, M. (Karlsruhe Univ. (TH) (Germany, F.R.). Engler-Bunte-Institut). *Gas- Wasserfach, Gas-Erdgas;* **118**: No. 10, 452-455(Oct 1977). (In German).

In conventional gas-fired heating systems, 82-85% of the enthalpy of the gas are conducted to the heating water or heating air. The operational efficiency of a heating system depends mainly on the size of the system and the losses due to operation. Two thirds of the total operation time of heating vessels are outage periods. For boilers with hot-water-preparation this is, in summer, even four fifths. The yearly efficiency of heating vessels without hot water preparation is, compared with the nominal value, reduced by appr. 5%. Differences are due to the control and the construction of the heating system. Possible ways of improvement are discussed.

33275 Saving energy by valves. Sander, W. *Wasser, Luft Betr.;* **21**: No. 9, 494-495(Sep 1977). (In German).

The thermal fluids used nowadays have one great disadvantage, viz., their ability to convey heat is only about half as much as that of water. This gives rise to large problems both for the planners and operators of the installations concerned as well as for manufacturers of pumps, etc.

33276 District heating plant with fluidized-bed firing. Lindberg, P.H. (Kymi Kymmene, Heinola (Finland)). *Energie;* **29**: No. 8, 242-243(Aug 1977). (In German).

The article discusses the advantages and disadvantages as well as the automatic control of a fluidized-bed furnace used in a heating plant supplied by Messrs. Kymi Kymmene, Heinola, Finland, on a key-turn basis.

33277 Role of vessels in district-heating plants. Neil, D. (Neil (D.J.) Ltd., Macclesfield (UK)). *Energie;* **29**: No. 8, 260-263(Aug 1977). (In German).

First of all, the article outlines the development of large district heating networks and then proceeds to discuss the construction of boilers for district heating. The differences in construction are due to the different fields of application listed below: 1. Transportable hot-water stations for periodical use in the initial stages of limited heating networks for groups of consumers. 2. Large, stationary hot-water boilers for full-scale heating networks. 3. Large hot-water boilers for reserve and peak load supply in heating power systems. 4. Waste heat boilers, to be used in refuse incineration plants in combination either with pure heating systems or with heating power systems. 5. High-pressure steam boilers for heating power plants. 6. Waste heat boilers connected in series with gas turbines.

33278 Calculation of heat pump air conditioning systems with air circulation. Moeller, H. *Waerme;* **83**: No. 4, 57-64(Aug 1977). (In German).

After some general remarks on the double function of heat pumps in air conditioning systems, model calculations for a heating and a refrigeration plant are given in separate chapters. The performance numbers to be expected theoretically show the great economic advantages of this type of plant which may, however, be strongly affected by tariff policies.

33279 Ways to conserve energy - efficient energy use. Schaefer, H. (Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Energiewirtschaft und Kraftwerkstechnik). pp 5 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection. International congress on energy and environment; Duesseldorf, Germany, F.R. (8 Feb 1977).

Illustrated by examples taken from the private and industrial sector, possibilities of efficient energy utilization by the last consumer in a line, and possibilities for lowering specific energy investments are discussed. Technical and non-technical measures make it unquestionally possible to reduce energy consumption while maintaining comfort standards.

33280 Aktionsprogramm der Gemeinschaft im Bereich der rationellen Energienutzung (REN) - 2. Serie, Richtlinien und Empfehlung. Vorschlag fuer eine Richtlinie des Rates betreffend Leistung, Regelung, Wartung und Kontrolle von Waermeerzeugern sowie die Isolierung der Waermeverteilungsnetze in Neubauten. (Action programme of the Community in the field of efficient energy utilization (REN) - 2nd series, guidelines and recommendations. Proposal for guideline of the Council concerning performance, regulation, maintenance and control of heat generators as well as the insulation of heat distribution networks in new buildings). Bonn-Bad Godesberg, Germany, F.R.; Heger (Jun 1977). 17p. (In German).

Within the framework of the action program of the Community for efficient energy utilization, the Commission suggests to the Council to issue a guideline on the basis of which member states make sure that every type of heat generator for space heating and central hot water supply in new buildings is subjected to construction type licensing through appropriate inspectorates; heat generators according to this guideline are fossil-fuel fired hot water boilers, steam boilers and warm air generators. Another recommendation is proposed to the member states according to which the heating systems in new public buildings are fitted with automatic control in order that room temperatures do not exceed 20°C; in new residential buildings the heat flow is to be regulated in dependence of outer and inner temperature, the temperature of service water is not to exceed 60°C, and every room is to be fitted during construction work with measuring devices for heat and hot water supply. A further recommendation concerns the setup of internal organization units for carrying out energy conservation programmes. Finally, it is recommended that individual member states make use of advisory bodies for combined heat/power production; they are to advocate in particular an increase in heat supply from public power stations, if this is economically justified, and a concentration of heat generation and increased application of combined heat/power production in industry.

33281 Electrical block storage air heating plant. Buettner, R. (to Licentia Patent-Verwaltungs-G.m.b.H., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,233,413/B/. 28 Apr 1977. 2p. (In German).

The invention concerns an electrical block storage air heating plant, in which during discharge of the block storage heater by pumped air, no air flow from the inside to the outside can arise in the block storage heater, which would entail heat losses, neither is the fan in contact with hot air from the block storage heater and thermally stressed by it. For this purpose, the block storage heater is arranged in an air tight chamber, which has air introduced from the outside by a fan during discharging, and from which the bloack storage heater obtains the air to be heated via an air inlet channel. The heated air is taken from the block storage heater to the rooms to be heated through hot air channels. According to the invention the chamber is always at a higher pressure relative to the block storage heater during discharge, via an inlet pipe connected to the pressure side of the fan.

33282 Mitteilung der Kommission an den Rat ueber Energieeinsparungen durch Modernisierung von Altbauten. Unterrichtung durch die Bundesregierung. (Information by the commission to the council concerning energy conservation by modernizing old buildings. Information by the Federal Government). Bonn-Bad Godesberg, Germany, F.R.; Heger (1977). 5p. (In German).

The Commission of the EC proposes to the Council to issue a guideline for energy conservation by modernizing old buildings. It is to ask Member States to stipulate measures for modernizing old buildings which are considered to be inhabitable for at least another 20 years. These measures are to refer to improved wall and roof insulation, double glazing, improved heating systems and the introduction of thermostats and heat counters.

33283 Automobile engines as miniature heating power plants for one-family dwellings. Titl, A. *Sanit. - Heizungstech.;* **41**: No. 9, 540-544(1976). (In German).

The use of automobile engines in heating power plants for heat supply in small supply networks or single-family houses is discussed. Combined heat and power generation by means of internal combustion engines, utilization of engine waste heat for heating purposes, unit-type heating power plants for power, and heat supply to residential areas are considered. Technical data of two Heidenheim plants are given.

33284 Optimum thermal insulation as investment calculation problem. Daeumler, K.D. (Kiel Univ. (Germany, F.R.)). *HLH, Z. Heiz., Lueftung, Klim., Haustech.;* **27**: No. 6, 203-205(1976). (In German).

In the Federal Republic of Germany, almost 60% of the total end energy consumption goes towards heat, two thirds of the end energy heat are used in high building construction for heating purposes, i.e. 40% of the energy consumption in the Federal Republic is used for heating. If energy saving measures in the sector 'heating in high buildings' is to be effective, the use of energy saving measures expressed in Marks and Pfennigs must be at least as big as the cost expenditure for it. A simplified calculation shows that each thermal insulation measure is advantageous if it does not cost more than (1/i) times the reduction in heat costs caused by it, where i is the rate of interest. This is only valid if the energy costs remain constant. If one takes its annual increase into consideration, essentially higher expenditures for heat insulation are still economically of advantage.

33285 Heat pumps: heat recovery. Pielke, R. *Elektriker;* **15**: No. 7/8, 177-183(1976). (In German).

The author firstly explains in a general manner the functioning of the heat pump. Following a brief look at the future heat demand and the possibilities of covering it, the various methods of obtaining energy (making use of solar energy, ground heat, and others) and the practical applications (office heating, swimming pool heating etc.) are explained. The author still sees considerable difficulties in using the heat pump at present on a large scale. Firstly there is not enough maintenance personnel available, secondly the electricity supply undertakings cannot provide the necessary electricity on a wide basis without considerable investments. Other possibilities to save energy or to use waste energy are at present easier and more economical to realize. Recuperative and regenerative systems are described.

33286 (DOE-tr—84) **Economic heating in industry by means of operating measurement, control, and regulation technology.** Dehner, C.E. Translated from *Energieanwendung;* **24**: No. 2, 44-48(Feb 1975). 13p. NTIS, MF A01.

Portions of document are illegible.

Methods and equipment for controlling the room temperature in East German industrial plants in order to achieve energy conservation are discussed. (LCL)

33287 (DOE-tr—82) **Improving the efficiency of room heating in residential and commercial construction.** Doehler, W. Translated from *Energieanwendung;* **21**: No. 12, 369-370(Dec 1972). 6p. Dep. NTIS, PC A02/MF A01.

Recommendations are made for decreasing the fuel consumption required to heat houses and commercial buildings in East Germany. These recommendations include better thermal insulation on buildings and centrally controlled heating systems with individual room heat shut-off capabilities. Government regulations and actions to implement these programs are discussed. (LCL)

RESIDENTIAL BUILDINGS

REFER ALSO TO CITATION(S) 33232, 33255, 33307

33288 (HCP/B50073—02) **Arizona electrical energy load management demonstration project. Appendix B.** (Arizona Solar Energy Research Commission, Phoenix (USA)). Feb 1978. Contract EM-75-F-01-8161. 151p. Dep. NTIS, PC A08/MF A01.

Appendix-B is a supplementary document for the presentation titled "Final Report", Electrical Load Management Demonstration Project, dated February 14, 1977. The Appendix is intended to be a reference base only. Consequently, no effort has been made to establish continuity between the sections. The sections include: sample selection; rate design; billing procedures; hardware acquisition and installation; survey procedures; results and conclusion report; and graphical analysis of the raw data. (LCL)

33289 (NP—22867) **Reflections on the future development of electric domestic heating in the FRG.** (Hauptberatungsstelle fuer Elektrizitaetsanwendung e.V., Frankfurt am Main (Germany, F.R.)). 1976. 121p. (In German). Dep. NTIS (US Sales Only), PC A06/MF A01.

Data are presented on the development trends in the FRG in the field of electric space heating. The first chapter deals with the situation before and after the oil supply crisis. After this, the development of the housing situation up to 1980 is discussed, including the heating structure. Finally, possible ways to meet the energy demand for space heating are discussed with all their possible variants. Forecasts of the heating structure in 1985 are presented.

OFFICE BUILDINGS

33290 (AD—044942) **Infrared thermography of buildings: qualitative analysis of window infiltration loss, Federal Office Building, Burlington, Vermont. Special report.** Munis, R.H.; Marshall, S.J. (Cold Regions Research and Engineering Lab., Hanover, N.H. (USA)). Sep 1977. 22p. (CRREL-SR—77-29). NTIS PC A02/MF A01.

An interior, infrared thermographic survey of single-pane, aluminum-frame, projected windows was performed to pinpoint locations of excessive infiltration. Infrared thermographic inspection accomplishes this more quickly and more accurately than conventional techniques of studying window infiltration. This report pre-

sents 32 thermograms and photographs which in many cases dramatically illustrate infiltrations (1) around the mullions, (2) along the top opening cracks, and (3) under the frame/sill interfaces. Poor glazing seals were easily detected and the exact points of glass/frame leakages were pinpointed. Plumes of warm air on the window glass, rising from the convectors, were dramatically captured by the infrared camera system. In several cases, the plumes were noted 12 fr. above the convectors on the top window panels. Heat loss from the convectors was noted through the walls of the building in thermograms taken from the outside. Several recommendations were prepared for the General Services Administration, owner of this Federal Office Building in Burlington, Vermont.

SCHOOL, MUNICIPAL AND OTHER PUBLIC BUILDINGS

REFER ALSO TO CITATION(S) 32911

COMMERCIAL AND INDUSTRIAL BUILDINGS

33291 Heat recovery in air conditioning. Gnugesser, E. (Kraftanlagen A.G., Heidelberg (Germany, F.R.)); Goehringer, P. *Verfahrenstechnik (Mainz);* **11**: No. 10, 588-592(Oct 1977). (In German).

The article deals with heat recovery in industrial air conditioning. Most of the heat contained in the waste air may be recovered by combining ventilation systems with regenerative or recuperative heat exchangers. Although the temperature difference in air conditioning systems is maximally 40 K, economical heat recovery is made possible by the relatively large amounts of circulating air. In process-air conditioning system, the high waste air and flue gas temperatures and the long daily periods of operation enable great energy savings. It should always be determined which type of heat recovery is technically and economically most suitable for the case in question.

33292 Role of the condensate economy in small and medium business. Rippe, M. *Maschinenmarkt;* **83**: No. 32, 633-635(Apr 1977). (In German).

In industry and trade, steam has never lost its importance as a heat carrier. Its firm place among heat carriers is not the least due to its properties. For example, it may be generated in a central unit, it is easy to distribute, and it may be used more than once. Until now, however, steam generation has received more interest than its economic advantages and condensate recirculation. One possibility of lowering heating costs is by utilizing condensate heat. This may be achieved by recirculating the expansion steam generated in the superheated-steam condensate or by direct utilization of condensate heat for heating purposes.

33293 Gas-infrared-radiation heating - a well-developed system. Vogel, W. *Ind.-Anz.;* **98**: No. 58, 1051-1053(1976). (In German).

Illustrated by the example of the heating of a workshop in a steel plant, the contribution at hand shows that in the case of higher halls gas-infrared-radiation heating is more economical than warm air heating.

TRANSPORTATION

REFER ALSO TO CITATION(S) 33261, 33263

33294 Simultaneous equation model of travel demand. Stahl, D.O. II. (North Carolina Dept. of Administration, Raleigh). *Transp. Eng. J.;* **103**: No. TE6, 741-750(Nov 1977).

A simultaneous equation travel demand model, derived from a choice-theoretic foundation, is conceptually simple, compact, and comprehensive. The advantages over traditional models are: (1) Trip generation sensitive to trip attributes such as travel time and costs; (2) total demand sensitive to substitution opportunities arising from system changes; (3) uniform estimates of the value of time and other common parameters throughout the model; and (4) the efficiency of full-information estimators. A supply function, describing the effect of traffic volume on trip attributes, and an iterative solution process is required for forecasting. An index of social welfare consistent with individual values implicit in the model can be calculated and used to evaluate alternative proposals for improving the tranportation system.

AIR AND AEROSPACE

REFER ALSO TO CITATION(S) 33248, 33249

RAILWAY

REFER ALSO TO CITATION(S) 33194, 33352

LAND AND ROADWAY

REFER ALSO TO CITATION(S) 33353

33295 (PB—272714) **Costs and energy efficiency of a dual-mode system.** Heft, R.C.; Borden, C.S. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 30 Apr 1977. Contract DOT-AT-60008. 77p. NTIS PC A05/MF A01.

This report represents a more detailed examination of two areas of a previous analysis on a Dual-Mode System as documented in 'Technical and cost considerations for urban applications of dual-mode transportation' (JPL, May 1972). It uses the technical and cost data of the previous report and employs the life-cycle cost approach. This report consists of two parts plus the Appendices: (1) An economic analysis, and (2) An energy consumption analysis. The economic analysis examines the present value life-cycle costs of the system for both public and semi-private ownership and presents the costs in terms of levelized required revenue per passenger mile. Two transit modes associated with a high-speed guideway system are included (pallets and command actuated passenger service (CAPS) vehicles). The energy consumption analysis considers the energy use of the various dual-mode vehicles by means of a detailed vehicle simulation program for the control policy and guideway system as described in the previous study.

33296 Abstract-mode approach to small-city transit-ridership estimation. Popper, R.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Allegra, M.A. pp 147-151 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Developing forecasts for small town transit ridership has always been difficult, especially for those communities currently without a public transit system. Deficiencies in existing forecasting models due to excessive computational length or the inability to accurately assess ridership has led to the development of a methodology for intra-city demand estimation called the abstract mode model. This model relates various alternative transportation modes in terms of their service characteristics, which indicates that as the quality of service improves, the volume of trips will increase for any of the alternative modes. The model will predict ridership for various levels of service and summarizes the conventional methodology of trip generation, trip distribution and modal split into one combined step. Seemingly good results were obtained by applying this model to a small town situation. The statistical and logical conclusions of the model were reasonable, especially when compared to a similar city with a transit system. The model was extremely sensitive to travel times of alternative modes, especially transit waiting times and transfer times. This indicates that the reliability and efficiency of a transit system is quite crucial to predicting ridership. The conclusions are that this methodology appears reasonable for predicting transit ridership in small cities that have no transit system and a limited amount of travel and socio-economic data available.

PIPELINE

REFER ALSO TO CITATION(S) 34026

33297 Problem of non-destructive testing and judging of welded seams on plastic pipelines. Herforth, H.; Neitzel, M. *Brunnenbau. Bau Wasserwerk. Rohrleitungsb.;* **27**: No. 1, 5-9(Jan 1976). (In German).

Within the framework of the increasing use of plastic pipelines, the growing problem of the quality control of welded joints is posed, particularly on pipes of polyethylene. The standard of technology is explained, and the possibilities for securing quality which should be consequently applied are illustrated by the example of the control of bedding and welding of pipelines in the large filter plant of the BASF AG. The necessity of further development of X-ray and ultrasonic methods is brought forth, and it is attempted to make one aware of the significance of these tests for plastic pipelines, too.

INDUSTRY AND AGRICULTURE

REFER ALSO TO CITATION(S) 33233, 33261, 33279, 33286

ENERGY SOURCES

REFER ALSO TO CITATION(S) 33230

MATERIALS

REFER ALSO TO CITATION(S) 33230

EQUIPMENT AND PROCESSES

REFER ALSO TO CITATION(S) 33230, 33444

33298 Work regimes of energy boilers under conditions of recirculation of flue gas in the combustion zone. Strikha, I.I.; Aleksashina, R.A. *Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk;* No. 4, 45-52(1977). (In Russian).

A comparative estimate of the energy expenditures of the TP-87 boiler operating with combustion gas recirculation in the air duct and in the furnaces is given. A graphic-analytical method of determination of the amount of recirculation gas needed to achieve a required superheated steam temperature under the conditions of a partial mixture of recirculating and combustion gases is proposed.

33299 (DOE-tr—83) Emergence of energy consumption norms for electrically heated industrial installations. Kinder, H.; Kretschmer, R. Translated from *Energieanwendung;* **23**: No. 8, 245-247(Aug 1974). 11p. Dep. NTIS, PC A02/MF A01.

Recommendations are made for developing energy consumption norms for electric industrial furnaces used in the German Democratic Republic. Information is included on furnace production, thermal insulation, heat losses, heat storage, and optimum operation for energy conservation. (LCL)

33300 (DOE-tr—85) Emergence and application of energy consumption norms in the construction of industrial furnaces in the GDR. Lange, W. Translated from *Energieanwendung;* **23**: No. 8, 240-242(Aug 1974). 8p. Dep. NTIS, PC A02/MF A01.

The establishment of legal guidelines of the Socialist State, i.e., the German Democratic Republic, in order to specify measures which will increase the production of industrial furnaces and which will reduce the energy consumption in producing these furnaces is discussed. (LCL)

WASTE HEAT RECOVERY AND UTILIZATION

REFER ALSO TO CITATION(S) 33229, 33233

33301 Closed water reuse system for power plant cooling and digester heating. Chiu, Y. (George Washington Univ., Washington, DC); Guey-Lee, W. *Water Resour. Bull.;* **13**: No. 6, 1203-1214(Dec 1977).

A model consisting of closed water reuse and productive use of various types of wastes for energy generation is presented. The sewage after treatment would be used as the cooling water for power plants, and the condenser discharge therefrom be used as heating water for sludge digesters. The water is then purified for municipal water supply for continuous use. The advantages of this system are that water resources and energy are conserved while various types of wastes including waste heat are controlled. With a preliminary system analysis, it appears that the design for power plant based on the total heating value of wastes and digester capacity based on sewage sludge generation is feasible in terms of acquisition and full utilization of various types of wastes as generated in a single metropolitan area. The system as shown in this design is in balance among various factors such as the generation rate of municipal refuse, municipal sewage, waste heat in the condenser discharge, and raw sewage sludge.

INDUSTRIAL WASTE MANAGEMENT

REFER ALSO TO CITATION(S) 32873

33302 (EHE—76-04) Survey: suitability of clay beds for storage of industrial solid wastes. Report to Texas Water Quality Board. Sanks, R.L.; LaPlante, J.M.; Gloyna, E.F. (Texas Univ., Austin (USA). Center for Research in Water Resources). 30 Jun 1975. 201p. (CRWR—128). of Texas, Austin.

Includes Addendum: Investigation of uptake characteristics of various clays for selected heavy metals.

Landfills are a practical and economic solution for the disposal of industrial wastes. Such landfills must be properly designed and operated to insure that undesirable substances do not leach from the wastes into the surrounding biosphere. A project undertaken to develop test procedures that could be used to design landfills or clay pits, as solid waste repositories is described. The specific objectives were to: develop test procedures for measuring the action of a broad number of potential soil pollutants; observe and report factors that affect repeatability and accuracy of determinations; study a few widely diversified materials to promote insight into the action of industrial wastes; and assess the suitability of clay formations as disposal sites. Literature on sanitary landfills and leaching of chemicals in soils was reviewed. The clays studied are described. The equipment and procedures for and results from clay characterization studies are discussed. It was concluded from this study that: industrial solid wastes can be stored in selected geological locations, and sanitary landfills can be designed to contain and sequester specified wastes; rational design of clay pits requires knowledge of the characteristics of the soil and ground water at the site and the amount and characteristics of the wastes; all five Texas clays investigated were highly impermeable and could provide a substantial barrier to the migration of pollutants; a simple method for determining the permissible waste loading in a clay pit was developed; and further research on sorption in high density clays and a demonstration experiment would be useful. (LCL)

33303 Solid waste management. Available information materials: interim catalog from January 1966—October 1977. Lederer, F.P. (comp.). Washington, DC; Environmental Protection Agency (1977). 199p. GPO.

The importance of collecting and making available the information pertaining to solid-waste-related research, demonstration projects, and other activities was originally authorized by Section 204(b) of the 1965 Solid Waste Disposal Act, Public Law 89-272. The collection and dissemination of solid waste information was mandated by the new solid waste legislation, the Resource Conservation and Recovery Act of 1976, in Section 8003. A comprehensive bibliography is presented which lists publications and other educational materials that have been published or collected by the Office of Solid Waste, U. S. Environmental Protection Agency, in response to these directives. Its content reflects the entire scope of the work undertaken by EPA's solid waste-program from 1966 to the present and is intended for the serious investigator.

33304 Coprecipitation of acid cheese whey and tannery waste and recovery of protein. Townend, R.E. (Eastern Regional Research Center, Philadelphia). *Biotechnol. Bioeng.;* **20**: No. 4, 589-599(Apr 1978).

Combining acid cottage cheese whey and the lime-sulfide effluent from tannery unhairing processes spontaneously coprecipitates the whey proteins with the large peptides and proteins of the tannery waste. The flocculation of the denatured protein material also carries down the hide pigments, excess lime, and the casein fines from the whey. The clear supernatant contains lactose, sulfur in various states of oxidation, free amino acids, peptides, and ammonium salts, but no detectable macromolecular proteins. The recovered solid products, which contain more than 20% of the original nitrogen, appear to have a good balance of essential amino acids although actual composition varies with the composition of the raw wastes. Feed supplements may possibly be obtained by this method from two presently wasted industrial effluents.

33305 Saving energy by using aluminium alloys. Uhlig, G. *Metall;* **31**: No. 10, 1052-1053(Oct 1977). (In German).

In a Metall interview, Dr. Gottfried Uhlig, managing director of the Vereinigung Deutscher Schmelzhuetten, answered questions on topical problems of aluminum works and their future development. The problems discussed in this context related to growth problems of the primary industry, future markets, aluminum recycling, energy balance, environmental protection, and competition.

MUNICIPALITIES AND COMMUNITY SYSTEMS

PUBLIC UTILITIES

REFER ALSO TO CITATION(S) 33256

33306 (ORNL/HUD/MIUS—42) Initial simulation and control system studies of the MIUS coal-fired turbine experiment. Ball, S.J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1978. Contract W-7405-ENG-26;EX-76-C-01-1742. 60p. Dep. NTIS, PC A04/MF A01.

The fluidized-bed coal-fired gas turbine (CFGT) experiment is part of the Modular Integrated Utility System program, which is jointly sponsored by the Department of Housing and Urban Development and the Department of Energy. The dynamic characteristics of the CFGT experiment were investigated to determine specific control-system designs required to satisfy varying electrical and waste heat demands and, at the same time, to keep plant component temperatures and stresses within acceptable limits. The simulations indicate that the present control system design is capable of handling expected load transients satisfactorily.

33307 (ORNL/HUD/MIUS—45) Reliability considerations for a coal-fired modular integrated utility system. Samuels, G. (Oak Ridge National Lab., Tenn. (USA)). Feb 1978. Contract W-7405-ENG-26;EX-76-A-01-1742. 46p. Dep. NTIS, PC A03/MF A01.

A statistical analysis is made to estimate the availability and power outage rates for a coal-fired Modular Integrated Utility System composed of four to six parallel power modules in which there are two modules in excess of those required to meet the system's critical load. The analysis includes estimates of the mean time between failure and the mean time to repair for the various subsystems and the effects of several methods of operation on the

outage rate. With an operating procedure in which excess capacity when available is on-line, the total plant downtime for a four- to six-module plant is estimated to be in the range of 5 to 10 hr/year. This range of values would be expected only after a shakedown period to debug the system and an extended operating period to establish preventive maintenance procedures.

33308 (ORNL/HUD/MIUS—46) **Alternate operating conditions and systems for the coal-fired Modular Integrated Utility System.** Samuels, G.; Wells, W.M. (Oak Ridge National Lab., Tenn. (USA)). Feb 1978. Contract W-7405-ENG-26;EX-76-A-01-1742. 54p. Dep. NTIS, PC A04/MF A01.

An analysis is made to determine the effects of varying the operating conditions of a coal-fired closed-cycle gas-turbine modular-integrated utility system on the efficiency and cost of the plant and to evaluate the merits of using an organic Rankine system for this application, either as a single cycle or in combination with the gas-turbine system. The electrical efficiency and overall fuel utilization of the reference gas-turbine plant are severely degraded by reducing the turbine inlet temperature. The electrical efficiency is reduced about two points for each 100°F (56°K) reduction in temperature, with little, if any, change in the cost of the plant over a temperature range from 1500 to 1200°F (1089 to 922°K). A single-cycle organic Rankine system is not well suited for this application and would, at best, be very marginal. The addition of an organic Rankine secondary cycle to the gas-turbine system offers the potential for significant improvements in both efficiency and cost over that of the reference gas-turbine plant.

MUNICIPAL WASTE MANAGEMENT

33309 (PB—272757) **St. Louis demonstration: refuse processing plant equipment, facilities, and environmental evaluations. Final report Sep 74—Sep 75.** Fiscus, D.E.; Gorman, P.G.; Schrag, M.P.; Shannon, L.J. (Midwest Research Inst., Kansas City, Mo. (USA)). Sep 1977. Contracts EPA-68-02-1324;EPA-68-02-1871. 349p. NTIS PC A15/MF A01.

The report presents the results of processing plant evaluations of the St. Louis-Union Electric Refuse Fuel Project, including equipment and facilities as well as assessment of environmental emissions at both the processing and power plants. Data on plant material flows and operating parameters, plant operating costs, characteristics of plant material flows, and emissions from various processing operations were obtained during a testing program encompassing 53 calendar weeks. Refuse derived fuel (RDF) is the major product (80.6% by weight) of the refuse processing plant, the other being ferrous metal scrap, a marketable by-product. Average operating costs for the entire evaluation period were $8.26/Mg ($7.49/ton). The average overall processing rate for the period was 168 Mg/8-hr day (185.5 tons/8-hr day) at 31.0 Mg/hr (34.2 tons/hr). Future plants using an air classification system of the type used at the St. Louis demonstration plant will need an emissions control device for particulates from the large de-entrainment cyclone. Also in the air exhaust from the cyclone were total counts of bacteria and viruses several times higher than those of suburban ambient air. No water effluent or noise exposure problems were encountered, although land-fill leachate mixed with groundwater could result in contamination, given low dilution rates.

ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

33310 (CONF-771037—) **Highway vehicle systems.** (Department of Energy, Washington, D.C. (USA). Div. of Transportation Energy Conservation). Mar 1978. 451p. Dep. NTIS, PC A20/MF A01.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

Forty-six papers were presented on the various activities of DOE contractors currently engaged in automotive research. A separate abstract was prepared for each paper for inclusion in Energy Research Abstracts (ERA). (PMA)

33311 (CONF-771037—, pp 3-5) **Highway Vehicle Systems Program overview.** Brogan, J.J. Mar 1978.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The objectives of the Highway Vehicle Systems Programs of the DOE are briefly reviewed and some of the new directions which are emerging pointed out. The program relates to automobiles, trucks, and buses which consume about 75 percent of all the energy used in the transportation sector of our economy. At present, all of this energy comes from petroleum sources.

33312 (CONF-771037—, pp 13-15) **Overview of vehicle systems projects.** Meisenholder, G. Mar 1978.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The Jet Propulsion Laboratory (JPL) functions in a manner similar to NASA Lewis Research Center in filling the role of Project Managers for the DOE Program on Vehicle Systems. The basic intent of this program is to view the major components and subsystems of a vehicle from the systems viewpoint and not as just a transmission or just an engine, or just a control, etc. The vehicle is viewed as a system not only within itself, but on the road within the societal environment. This more comprehensive approach is to make sure that there are no fundamental road blocks or barriers to the ultimate introduction of advanced engines when and as they reach maturity and are ready for introduction into the marketplace.

33313 (CONF-771037—, pp 28-31) **VEEP: a Vehicle Economy, Emissions, and Performance Simulation Program.** Klose, G.J. Mar 1978.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A brief description is given of the VEEP simulation computer program. The purpose of the program is to: predict vehicle fuel economy and relative emissions over any specified driving cycle; calculate various measures of vehicle performance (acceleration, passing manuevers, gradeability, top speed); and give information on the various categories of energy dissipation (rolling friction, aerodynamics, accessories, inertial effects, component inefficiencies, etc.). The vehicle is described on the basis of detailed subsystem information and detailed numerical parameters characterizing the components of a wide variety of self-propelled vehicles.

INTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 33174, 33397

33314 (CONF-771037—, pp 8-12) **Heat engine system projects overview.** Krasner, M.H. Mar 1978.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A brief discussion is given to provide some background and orientation for the DOE Heat Engine Program. Topics discussed include: elements of the DOE/NASA organization, functions of NASA Project Offices, general approaches to project implementation, and how to get involved.

33315 (CONF-771037—, pp 31-40) **USPS Light Delivery Vehicles Program.** Hull, W.E. Mar 1978.

From ERDA contractors[7] coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Ths U.S. Postal Service has a program to look at improved vehicles as candidates for use in its fleet to achieve minimum vehicle costs and to reduce the use of, and dependence on, oil based fuels. As part of this program, a number of internal combustion engines, electric and hybrid propulsion systems are being tested and evaluated. Some of the systems under evaluation are described and some of the test results to date are presented. Systems discussed include: diesel engines, stratified charge engines, hydrogen-fueled engines, battery-powered systems, and hybrid battery/flywheel systems.

33316 **Internal combustion engine.** Fleischer, P. German(FRG) Patent 2,536,764/A/. 3 Mar 1977. 5p. (In German).

An internal combustion engine is described where all moving parts, cylinders as well as pistons, rotate at a constant distance around two separate fixed points without using cranks or eccentrics. A change of direction of the piston is thus avoided, and a higher efficiency is achieved.

SPARK-IGNITION

REFER ALSO TO CITATION(S) 33394

33317 **Stratified charge engines.** London; Institution of Mechanical Engineers (1977). 192p. .

From Conference on stratified charge engines; London, England (23 Nov 1976).

Twenty-one papers on theoretical and experimental aspects of stratified charge engines were presented at the Conference. A separate abstract was prepared for each paper for inclusion in DOE Energy Research Abstracts (ERA). (PMA)

33318 **Experimental and theoretical investigations on a stratified charge engine with prechamber injection.** Pischinger, F.; Kreyken-

bohm, B.; Adams, W. (Technical Univ., Aachen). pp 1-6 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Stratified charge engines, especially engines with prechamber injection, give a lot of parameters to influence mixture formation and engine combustion. For the development of these engines, a principal understanding of the combustion process is required. At the Institute of Applied Thermodynamics at the Technical University Aachen, experimental studies were carried out on a single-cylinder test engine to classify the principal characteristics of the engine process. In addition, calculation models were developed, suitable for the computer simulation of the formation of pollutants during the engine process. From these studies, both experimental and theoretical, there results an extended knowledge about the power, efficiency, and pollutant emission behavior of the engine. The results show the influence of different fuel-air distributions within the charge on the engine characteristics and pollutant-formation. The conclusions drawn from model calculations are checked by a comparison between experimental and theoretical results. In addition, guide lines are obtained for an optimal engine design.

33319 Sensitivity of fuel economy characteristics in a dual chamber stratified charge engine. Varde, K.S. (Univ. of Michigan, Dearborn). pp 7-12 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Effects of nozzle geometry, amount of fixed fuel injection and its timing, scavenge valve operation, off-optimum and throttling on the engine fuel consumption and other engine characteristics were evaluated experimentally in a dual chamber stratified charge engine. Nozzle geometry and the amount of fuel injection in the auxiliary chamber influenced the engine thermal efficiency over the entire load range. Throttling the intake mixture and rendering the scavenge valve inoperative resulted in fuel penalty in the low load region while off-optimum ignition had a major influence in the high load range.

33320 Significance of fuel/engine interactions in the development of the stratified charge engine. Tipler, W. pp 13-20 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

In order to achieve the optimum results from current stratified charge engine programs, it is essential that development work on engines and fuels proceeds in a co-ordinated manner. In the case of petroleum fuels this approach can offer significant gains. Considering the possibility of liquid fuel production from coal, the integrated approach advocated could result in doubling the overall thermal efficiency of coal utilization for automotive purposes; it would also indicate that the carbureted type of stratified charge engine should be abandoned in favor of the injected type (or spark assisted diesel engine).

33321 Development of the PORSCHE SKS engine . Gruden, D.; Markovac, U.; Loercher, H. pp 21-27 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

PORSCHE is studying the development of the stratified charge engine. With their SKS engine, PORSCHE has tried to create optimum conditions for each of the combustion phases. The result was a divided combustion chamber with a three-stage combustion.

33322 Performance and emission control in stratified charge hydrogen fueled engines. Saga, K.; Furuhama, S. (Musashi Inst. of Tech., Tokyo). pp 29-36 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Three types of stratified hydrogen fueled systems were applied in several single-cylinder engines, both for control of emissions and abnormal combustion. First, hydrogen was injected into the cylinder directly by the two processes. In one of them, the injection was finished at an early part of compression stroke. Then the maximum output could be increased but not with lower NO/sub x/ emission; the thermal efficiency was lower because the mixing was incomplete. In the other process, high pressure hydrogen as the main fuel was injected accompanying the combustion. Prior to this a small part of hydrogen was induced into the intake manifold, which gave good control of NO/sub x/ emission. But further improvement of the thermal efficiency and durability of the injection system were required. Second, a single-cylinder engine was operated by injecting only low-pressure hydrogen into an auxiliary chamber during the early part of the compression stroke. In the case of the air-hydrogen engine, however, the combustion was accelerated excessively by the stratification. Therefore, this spoiled the control of NO/sub x/ formation. To make the matters worse, it reduced the engine performance and promoted preignition. Lastly, a small amount of hydrogen was injected into an auxiliary chamber to supplement the fuel in a gasoline fueled engine. From this a very lean mixture (over all lambda = 2.0) operation was achieved at the mass hydrogen ratio 0.05 to total fuel with low HC emission.

33323 Control of nitric oxide and carbon monoxide emission by two-stage combustion process. Ogasawara, M. (Osaka Univ.); Nishida, O.; Takagi, T.; Ohki, T. pp 37-44 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The fundamental characteristics of NO/sub x/ and CO emission are studied experimentally when two-stage combustion process is applied to modeled divided combustion chamber with and without expansion stroke. Fundamental parameters affecting the emission characteristics are examined to demonstrate that NO/sub x/ and CO emission can be greatly controlled by equivalence ratio and volume ratio of each combustion chamber divided, and the results also include which chamber is responsible for NO/sub x/ and CO formation when parameters are varied.

33324 British Leyland experimental stratified charge engines. Weaving, J.H.; Corkill, W.J. pp 45-54 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

A discussion is given of research carried out to date by British Leyland on dual-chamber three valve stratified charge engines designed to reduce pollutants and improve economy. The reduction of nitric oxide is achieved by operating at overall air/fuel ratios in the region of 20:1 while maintaining efficient combustion in order to improve the economy and control hydrocarbon emissions. Areas of research include pre-chamber volume, connecting throat size, prechamber valve timing and duration, prechamber air and air-fuel ratio optimization, inlet and exhaust manifold design and photographic studies of combustion. A theoretical investigation of engine losses is included.

33325 Combustion characteristics of a torch ignited engine: analytical measurements of gas temperature and mixture formation. Sakai, Y.; Kunii, K.; Sasaki, M.; Kakuta, N.; Aihara, H. (Nissan Motor Co. Ltd., Yokosuka, Japan). pp 55-64 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The combustion gas temperatures are measured by the sodium-line reversal method to analyze the combustion characteristics of the torch ignited engine. Further, the mixture formation processes are analyzed by gas sampling. The results show that the maximum gas temperatures in the torch ignited engine are not so low as expected, in spite of the lower NO/sub x/ emissions from the torch ignited engine compared with those from the conventional engine. It is considered that the results of the mixture formation analyses of the torch ignited engine give a good explanation for these phenomena.

33326 Unsteady flow and flame propagation in a prechamber of a stratified charge engine. Dwyer, H.A.; Sanders, B.R. (Sandia Labs., Livermore, CA). pp 65-70 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

An unsteady and one-dimensional model of the flow in the prechamber of a stratified charge engine was developed. The model allows for a detailed description of finite rate chemical kinetics and flame propagation, as well as the time development of the ignition process. The numerical method of solution of the model's equations allows for a resolution of the acoustic, chemical and diffusional time scales in the problem. For all of the cases considered a gas dynamic interaction occurs between the ignition process and flame propagation. This interaction is responsible for unsteady choking and unexpected pressure distributions in the prechamber. During the combustion process the flame seems to displace mass much like a piston, and large amounts of unburned fuel are emitted from the prechamber.

33327 Experimental results from Volkswagen's pre chamber stratified charge engines. Brandstetter, W.R. (Volkswagen Research and Development, Wolfsburg, Germany). pp 71-79 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Experimental results are reported from the PCI- and the 3-Valve-Stratified Charge Combustion process. Combustion bomb experiments and single cylinder engine tests are part of the fundamental investigations. Examples are given for the effect of operational parameters of emission performance of 4-cylinder engines. Components of the PCI-Concept are described. Vehicles with an inertia

weight of 1140 kg (2500 lbs) were tested according to the 1975 Federal Test Procedure. An analysis of the emission results indicates a potential for significant improvement by careful optimization of the cold start phase.

33328 Present experience with stratified charge engines working with initial separation of mixture components. Meurer, J.S. (MAN Werk, Augsburg). pp 81-87 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The mixture formation processes of modern diesel engines show that charge stratification can be carried to the point of charge separation and even as far as to maintain mixture components in different states until the start of combustion. The advantages and disadvantages of charge separation with engines burning gasoline fuel as well as prospects are treated. Results obtained to date show sound performance and good combustion control, similar to processes with enforced internal mixture formation. With naturally aspirated engines, BMEP levels up to 10.5 bar are being achieved. Remedies for exhaust gas odor and the mechanism causing it were found. The insensitivity of the stratified charge system to the octane rating of the fuel as well as to the different chemical compositions of the fuel is demonstrated by recent test results. Methanol in particular, even unblended, proved to be an excellent fuel for all conditions of operation, including cold starting.

33329 Stratified charge engines with open and subdivided combustion chamber. Oblaender, K.; Abthoff, J.; Fink, R. (Daimler-Benz AG, Stuttgart). pp 89-94 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

A discussion is given of the gas combustion processes in stratified charge engines, and these processes are compared with similar ones occurring in diesel engines. Topics covered include: engine design; fuel system; exhaust emissions and fuel-air ratio at steady speed; power; fuel consumption; and exhaust gas emissions and fuel consumption in transient testing. (PMA)

33330 Compared effects of single chamber and dual chamber charge stratification on NO/sub x/ emission and combustion efficiency. de Soete, G.G. (Institut Francais du Petrole, Rueil-Malmaison). pp 95-102 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Nitric oxide emissions are measured from two-layer stratified ethane/air mixtures, for different values of overall equivalence ratio and degree of stratification, both in the case of single chamber and in the case of dual chamber stratification. Depending on these parameters, it is shown that stratification may as well result in an increase as in a decrease of the NO emissions. A significant increase is also obtained when the combustion in the dual chamber mode presents the behavior of a self ignition. Stratification decreases thermal efficiency as soon as the stratification mode implies the coexistence of fuel lean and fuel rich mixture fractions.

33331 New stratified charge engine based on the Ricardo Comet design. Overington, M.T.; Haslett, R.A. pp 103-107 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The Ricardo Comet Mk. V combustion chamber is used extensively in small high speed diesel engines. By reducing the compression ratio to 12:1 and installing a spark plug in the prechamber, satisfactory operation was demonstrated on a range of fuels, including gasoline and gas oil. The principle of the combustion concept follows the ideal stratified charge arrangement, i.e., an unthrottled intake system, and the engine load is controlled only by the quantity of fuel injected. The combustion is initiated by the spark plug in the prechamber in the manner of a petrol engine, but the rate of combustion is controlled by the rate of fuel injection, as in a diesel engine. In this way, the design of the engine and fuel injection equipment can influence the peak cylinder pressures and engine noise. Results from a development program on a single cylinder engine are presented and the system is compared with conventional petrol and diesel engines.

33332 Influence of the degree of stratification on jet-ignition engine emissions and fuel consumption. Krieger, R.B.; Davis, G.C. (General Motors Research Labs., Warren, MI). pp 109-119 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

A single-cylinder jet-ignition stratifed charge engine was studied to determine the effect of richening the prechamber mixture supply at a fixed overall stoichiometry. Near a prechamber supply fuel-air equivalence ratio, phi/sub PS/, of 5, the NO and HC emissions decreased substantially, while CO emissions and fuel consumption increased substantially, when phi/sub PS/ was increased. A physical model was postulated to consist of three regions: the prechamber, the jet plume issuing from the prechamber, and the region in the cylinder surrounding the jet plume. The changes in exhaust emissions were explained using the physical model as a framework.

33333 Fundamental study into flame propagation through stratified mixtures. Karim, G.A.; Tsang, P.; Sarpal, G.S.; Badr, O. (Univ. of Calgary, Alberta). pp 121-126 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

Some aspects are described of an experimental program directed towards improving the understanding of the basic nature of flame propagation through known stratified mixtures of methane in air or through homogeneous flowing mixtures under simplified operating conditions. For example, it was shown that significant deviation from the quasi-homogeneous flame propagation approach appears to exist when a flame propagates along a negative concentration gradient through lean methane-air mixtures. This deviation at any point along the flame path is dependent on the equivalence ratio, the local concentration gradient and overall severity of the concentration build up along the flame path. Moreover, the lean flammability limit for the fuel is not significantly altered by mixture stratification.

33334 Cinematographic study of combustion in an enclosure fitted with a reciprocating piston. Oppenheim, A.K.; Cheng, R.K.; Teichman, K.; Smith, O.I.; Sawyer, R.F.; Hom, K.; Stewart, H.E. (Univ. of California, Berkeley). pp 127-135 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

A single pulse, compression-expansion machine simulating a reciprocating engine was constructed for the study of the fundamentals of engine combustion processes. Full optical access has allowed the making of high-speed, color, schlieren cinematographic records which show the processes of vortex generation by the piston, ignition by spark and torch igniters, and combustion. Torch ignition increased turbulence levels and permitted the burning of leaner mixtures than was possible with spark ignition. Product gases were collected and their chemical composition analyzed.

33335 LAG-process of combustion and its application in automobile gasoline engines. Gussak, L.A. (Inst. of Chemical Physics, Moscow); Turkish, M.C. pp 137-145 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

A novel fast combustion principle can be optimized from a dual combustion chamber form of spark ignited stratified charge engine to develop improved combustion and cycle efficiencies in automobiles. The combustion products of a small quantity of a very rich prechamber mixture create highly chemically active particles and, in combination with the turbulent vortex kernels formed by the torch entering the main chamber, generate a means of avalanche activation of combustion, which is termed LAG-process. This technology produces fast and complete combustion of lean fuel-air mixtures giving a 15% reduction of fuel consumption, a reduction in fuel octane requirements by at least 10 points, a significant reduction of the toxic exhaust emissions components and it improves engine durability.

33336 Photographic study of open-chamber stratified-charge combustion in a constant-volume bomb. Bergin, S.P.; Bolt, J.A. (Univ. of Michigan, Ann Arbor). pp 147-156 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The processes occurring in open-chamber, stratified-charge engines at low speed and load were simulated in a bomb and photographed on high-speed color motion-picture film. After spark-ignition is achieved, the flame kernel is first blown downstream by the swirling air, but the leading edge of the developed flame then assumes a relatively stable position on the fuel spray (of no. 2 diesel fuel), indicating that flame speed is at least as great as local convective velocity under the conditions tested. Combustion continues downstream of the rich flame front as more air is mixed into the burning zone.

33337 Recent development of Mitsubishi's stratified charge engine MCP. Miyake, M. (Mitsubishi Heavy Industries Co. Ltd., Nagoya, Japan). pp 157-166 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

The MCP (Mitsubishi Combustion Process) engine, a stratified charge engine with fuel injection into swirling air, permits stable combustion at very lean mixture. Low fuel consumption, low exhaust emissions, easy starting and multifuel capability are superior features of this engine. A newly developed MCP engine, the model G11L-D with the stroke volume of 510 cm^3 and the rated horsepower of 7.5 kW at 3400 rpm was placed on the market for the small harvesting machine in Japan. The continuing efforts toward the development of the new MCP engine are described. The injection system, having the delivery valve with a variable retraction volume, gives the stable and clean combustion under a wide range of running conditions. In order to ensure the multifuel capability, the effect of ignition and injection timing of combustion and/or exhaust emissions by using kerosene and diesel fuel were studied through combustion pressure analysis. A new contact breakerless ignition system MTI (Mitsubishi Transistor Ignitor) is also described. The MTI has the superior electrical discharge characteristics for the MCP engine with the long arc duration of 3 to 4 ms.

33338 Modeling of two-phase, two-dimensional, unsteady combustion for internal combustion engines. Bracco, F.V. (Princeton Univ., NJ). pp 167-187 of Stratified charge engines. London; Institution of Mechanical Engineers (1977).

From Conference on stratified charge engines; London, England (23 Nov 1976).

In the introduction, the following topics are considered: mass, momentum, and energy diffusivities; zero-dimensional modeling of deflagrations in closed vessels; one-dimensional steady and unsteady equations; two-dimensional models and combustion chamber configurations; and some details of the structure of premixed flames. In the review, it is indicated that two-dimensional models are currently available for combustion in reciprocating and rotary engines, with open and divided chambers, with uniform and stratified charges, but some not-too-restrictive limitations on the shapes of the various combustion chambers must be accepted. More importantly, it is indicated that the simulation of the controlling processes of chemical kinetics, turbulence, and wall heat and momentum transfer is at present rather rough; even more so than in earlier, simpler, one-dimensional models. Some of the shortcomings will be eliminated in the very near future, others only as knowledge of fundamental processes increases over a longer time span. Also reviewed are current multi-dimensional modeling efforts of engine spray combustion which are at a more primitive stage. The new results are for combustion in open and divided chamber reciprocating engines with uniform and stratified charges. These results relate to such important practical equations as the effects of throat size, turbulence and charge stratification in divided chamber configurations; maintenance of charge stratification in open chambers; and the methodology of comparison of multi-dimensional results with experimental flame propagation data. However, the restrictive nature of the physical assumptions currently embodied in the models, and the lack of direct comparison with correspondingly detailed experimental data, suggest that caution should be used in drawing conclusions. Yet the power of multi-dimensional models and the detailed nature of their results are undoubtedly evidenced.

33339 Neue Technik hilft Energie sparen. Beitrag der Herstellerindustrie zum 'Sinnvollen Energieeinsatz'. (New technology helps to save energy. Contribution of the production industry to 'rational energy use'). Rado, L. (comp.). Essen, Germany, F.R.; Vulkan-Verl. (1975). 32p. (In German).

This paper gives the producing industrial branches the possibility to present their contribution to the realization of energy utilization in space heating from their own point of view. As a result we see that the efficiency of the heat producers for nominal heating power is so high already that a significant improvement cannot be expected. Stress is instead laid on the reduction of the outage losses thus trying to obtain a better yearly efficiency of the whole system. Furthermore there is a trend towards simplification of the maintenance and improvement of power increase - improved control -. The essays contained in this booklet show a number of units which, combined with non-polluting energy, offer an optimal and profitable solution for heat production, service water heating, and ventilation. For modernizing an old building the proper solution can be selected out of the numerous gas consumption systems: space heater, storey heating, or central heating with gas. For all purposes the producing industrial branches today offer safe and profitable units.

DIESEL

REFER ALSO TO CITATION(S) 33320, 33334

33340 (KFK—2432) Determination of optimized running-in schedules for diesel engines. A system using radionuclide measuring methods. Volz, J. (Kernforschungszentrum Karlsruhe (Germany, F.R.). Lab. fuer Isotopentechnik; Karlsruhe Univ. (TH) (Germany, F.R.). Fakultaet fuer Maschinenbau). Mar 1977. 147p. (In German). Dep. NTIS (US Sales Only), PC A08/MF A01.

Thesis.

Experimental results and their interpretation that have led to an optimizing system for the determination of running-in schedules for diesel engines are presented. Through radionuclide measurements (radioactivation) the schedules can be optimized with respect to both reliability and economy. Detailed explanations are given for the influences of optimization - based on piston ring wear and liner wear - on the established running-in criteria engine power, specific fuel and oil consumption and surface state of piston ring and liner. All components of the system are described as well as a schedule for the optimization steps. Data from practical tests which were integrated parts of the system development prove the good performance of running-in schedules generated by the system.

TURBINE

REFER ALSO TO CITATION(S) 33367, 33368, 33369, 33370, 33371, 33372, 33373, 33374, 33375, 33376

33341 (CONF-771037—, pp 51-52) DOE/UMTA Gas Turbine Bus Program. Lombardi, P. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

An Interagency Agreement was signed between DOE, Transortation Energy Conservation, and DOT, Urban mass Transit Authority (UMTA), for a gas turbine bus program which would be mutually beneficial for both agencies. A brief outline of the scope, goals, and planning of the program is given.

33342 (CONF-771037—, pp 125-129) Gas turbine project status. Goette, W.E. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

An overview is given of the automotive gas turbine program being carried out at the NASA-Lewis Research Center. Topics discussed include project goals, project organization and approach, status, and plans for FY 1978. Development of the Upgraded Engine is continuing, with recent identification of key problem areas. Modified design of the aerodynamic components is under way with testing of the modified components planned for mid-FY 78.

33343 (CONS/9698—1) Improved ceramic heat exchanger material. Rauch, H.W. Sr. (General Electric Co., Philadelphia, Pa. (USA)). Nov 1977. Contract EX-76-A-31-1011. 36p. (NASA-CR—135292). Dep. NTIS, PC A03/MF A01.

Various ceramic materials in the form of small, monolithic bars were screened as candidate materials in heat exchanger structures for automotive gas turbine engines. The material finally selected consists of 60 w/o* petalite (LAS) and 40 w/o of a recrystallizable glass which converts during thermal processing to cordierite (MAS). This new material, GE-3200, was fabricated by Coors Porcelain Company into a circular honeycomb structure 53.3 cm diameter and 10.2 cm thick (21" x 4") and having 69.8 holes/cm^2 (450 holes/$in.^2$) of rectangular geometry. Dimensions of each cell are about 2.5 mm x 0.5 mm (0.1" x 0.02") with wall thicknesses about 0.20 mm (0.008"). Small bar-shaped specimens of the honeycomb were used to measure thermal, chemical, and mechanical properties and for macro- and microstructure examination. Cylindrical honeycomb specimens about 15.2 cm diameter and 10.2 in. thick (6" x 4") were sent to Ford Motor Company and are currently being tested in a gas turbine engine. Data obtained from testing the bar-shaped honeycomb specimens of GE-3200 and from testing bar-shaped honeycomb specimens of Corning 9455 were compared. Results indicate that GE-3200 has significantly better resistance to sulfuric acid and to sodium chloride than Corning 9455; thermal expansion of GE-3200 is higher than that of Corning 9455 (1.7 x 10^{-6}/°C vs. 0.65 x 10^{-6}/°C over the temperature range 25°C to 1000°C); mechanical properties of GE-3200 are higher in the tangential direction, but lower in the radial direction than Corning 9455; and during thermal cycling between R.T. 1000°C and R.T. -1100°C, GE-3200 tends to elongate while Corning 9455 tends to slightly contract. Overall assessment of GE-3200 properties, ease of material preparation, ready adaptability to honeycomb fabrication, and refractoriness qualify this new material as a candidate for heat exchanger application in automotive gas turbine engines.

EXTERNAL COMBUSTION ENGINES

REFER ALSO TO CITATION(S) 33175, 33314

33344 Possible applications, advantages and disadvantages of external-combustion engines. Boeswirth, L. (Hoehere Technische Bundes-Lehr- und Versuchsanstalt, Moedling (Germany, F.R.)). *Waerme;* **83**: No. 2/3, 37-40(Jun 1977). (In German).

The article deals with external-combustion engines. After a survey of the functioning of this type of engine, the advantages and disadvantages of the system are discussed. Finally, possible fields of application are outlined.

STIRLING CYCLE

REFER ALSO TO CITATION(S) 33370, 33377, 33378, 33379

33345 (CONF-771037—, pp 243-254) **Improved Stirling engine development.** Postma, N. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

At the last Contractors Coordination Meeting, the results of the ERDA sponsored study of the 80 to 100 hp automotive Stirling engine and the progress on the 170 hp Stirling engine development program were described and reviewed. In the presentation given, specific data from the 170 hp test program are provided, some of the problems encountered are described, and the overall plan for continuance of the program under a cost-sharing contract with DOE and NASA is reviewed. Fuel economy and exhaust emission (NO/ sub x/, CO, and HC) data are given.

33346 (CONF-771037—, pp 254-258) **Initial test results with single cylinder rhombic drive Stirling engine.** Cairelli, J.E. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

NASA Lewis Research Center (LeRC) through an interagency agreement has been made responsible for the technical management of the DOE Stirling Engine Program for Highway Vehicles. In support of the LeRC Stirling engine technology effort, an eight horsepower single cylinder rhombic drive Stirling engine was restored to operating condition. The Stirling engine is mounted in an engine-generator set, designated as GPU 3-2 (Ground Power Unit). The engine-generator set was built by General Motors Research Laboratories in 1965 for the U.S. Army and has recently been tested by NASA LeRC using helium and hydrogen as the working gas. A brief description is given of the GPU 3-2 hardware, the test methods used, and the result of these tests. Comparison is made to unpublished data from similar hydrogen tests performed by the U.S. Army at Fort Belvoir, Virginia.

RANKINE CYCLE

REFER ALSO TO CITATION(S) 33761, 34020

ELECTRIC-POWERED SYSTEMS

REFER ALSO TO CITATION(S) 32877, 33315, 33359

33347 (NATO/CCMS—61(Vol.2)) **Proceedings of the fourth international symposium on automotive propulsion systems. Volume II.** (North Atlantic Treaty Organization, Brussels (Belgium). Committee on the Challenges of Modern Society; Department of Energy, Washington, D.C. (USA). Div. of Transportation Energy Conservation). Feb 1978. 505p. (CONF-770430—P2). Dep. NTIS, PC A22/MF A01.

From 4. international symposium on automotive propulsion systems; Washington, DC, USA (17 Apr 1977).

Fifty-three presentations are given in Volume II with contents including: (1) automotive emissions; (2) powertrain components; (3) vehicle improvements; (4) alternative fuels; (5) electric and hybrid systems; and (6) concluding remarks. All of the technical papers presented are condensed versions of papers appearing in the original conference draft. A separate abstract was previously prepared for DOE Energy Research Abstracts (ERA) as being part of the DOE Conference 770430, parts 1 to 5 (draft). (PMA)

33348 Magnetically levitated railway with common reaction rail for a linear motor drive and an electro dynamic side guidance arrangement. Friedrich, R. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,543664/A/. 7 Apr 1977. 5p. (In German).

The invention concerns a magnetically levitated railway with common reaction rail for the linear motor drive and the electrical side guidance arrangement. While the electro-dynamic hovering process requires a high electrical conductivity of the reaction rails in order to reduce eddy current losses, these should show a relatively high resistance for the asynchronous linear motor to reduce losses of propelling force. These contradictory requirements can be fulfilled for a common reaction rail made of homogeneous material of high electrical conductivity according to the invention, by providing slits at right angles to the driving axis in the part of the reaction rail allocated to the linear motor. Thus the guidance system retains a low ohmic resistance, while the part of the reaction rail allocated to the windings of the linear motor has a relatively low ohmic secondary resistance, by which the border and end effects which reduce the propelling force can be appreciably reduced.

33349 Railway equipment with which vehicles are kept in a hovering position. Guenther, C. (to Messerschmitt-Boelkow-Blohm G.m.b.H., Muenchen (Germany, F.R.)). German(FRG) Patent 2,544,008/A/. 7 Apr 1977. 5p. (In German).

The invention concerns the suspension of the emergency element at the vehicle of a magnetically levitated railway. On loss of the magnetic field keeping the vehicle hovering, the emergency elements are suspended on the rail arrangement. The suspension should limit the impact of the emergency elements to the smallest possible physical force. According to the invention the suspension consists of a spring-damper combination with a linear spring characteristic and a damper with a square law characteristic. The conditions which the spring constants, damper parameters and maximum spring force must satisfy, are laid down in suitable formulae.

33350 Steered wheel for the support and/or steering of a vehicle, particularly hovercraft. Duell, H.J.; Kirchner, G. (to Siemens A.G., Berlin (Germany, F.R.); Siemens A.G., Muenchen (Germany, F.R.)). German(FRG) Patent 2,544,143/A/. 7 Apr 1977. 7p. (In German).

The invention concerns a steered wheel for the support or steering of a hovercraft, whose wheel suspension is provided with an eccentric journal for automatic setting in the direction of travel. So that the vehicle will not leave its track during changes of direction when the wheel is turned around the eccentric axis, according to the invention the wheel is supported on movable bearings at the journal in the direction of the driving axle.

33351 Contribution to linear induction machines with position-dependent conductivity of the secondary. Andresen, E.; Baertz, U. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Elektrische Energiewandlung). *Arch. Elektrotech. (Berlin);* **59**: No. 1, 23-37(Mar 1977). (In German).

Linear induction machines, such as the high speed ground transportation motor with discontinuously arranged stators along the guideway and controllable secondary on the train, further the liquid metal MHD convertor or the sector motor allow to be operated with reduced conductivity of the secondary outside the stator. The influence of a stator position dependent conductivity of the secondary on field and current distribution and on the characteristics is analyzed.

33352 Propulsion-system models for transportation-system simulation and energy-management studies. Pitel, I.; Kirby, B.; Talukdar, S. (Carnegie-Mellon Univ., Pittsburgh). pp 197-202 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Convenient models of power conditioners of the cam, chopper and phase control types and tractor motors of the dc series and parallel types are described. These are the most commonly used components in propulsion systems for electric powered trains. Their models are part of a simulation and optimization package that is being developed to find ways to conserve energy. Specimen output from completed portions of this package illustrates the uses to which the propulsion-component-models can be put.

33353 Simulation study of a flywheel-powered electric vehicle utilizing the modern high-energy-density energy-storage flywheel. Markus, D.R.; Drutz, R. (Carnegie-Mellon Univ., Pittsburgh). pp 287-292 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Modern inertial energy storage devices offer attractive possibilities as a power source in electric vehicles. To demonstrate this, a flywheel powered electric vehicle is designed and simulated in detail. Simulation is carried out subject to the characteristics of commercially available equipment; where actual device characteristic curves are used whenever possible. Hence, the effects of component nonlinearities and variable efficiencies as well as system constraints are included. Based upon this approach, vehicle performance may be evaluated in greater breadth and depth than traditionally done.

33354 Method for power supply and for an improvement of the power factor of a.c. networks. Foerster, J.; Golde, E. (to Licentia Patent-Verwaltungs-G.m.b.H., Frankfurt am Main (Germany, F.R.)). German(FRG) Patent 2,433,825/A/. 29 Jan 1976. 19p. (In German).

To improve the power factor in a.c. networks without using condensers to compensate strong inductive loads, e.g. due to traction motors, it is proposed to take current from the network in such a way that the a.c. controller is provided with a forced-commutation device in order to shift the current center of each half-wave forward.

33355 Power supply network for the Hamburg d.c. suburban train system. Lisson, P. *Elektr. Bahnen;* 47: No. 8, 191-198(1976). (In German).

The power supply systems and the computer-controlled central unit, which will also supply a.c. train systems, are described in detail. Power supply to the lighting and power systems in stations and stops of the d.c. suburban trains are only shortly mentioned.

33356 Technical and economic aspects of electric power transmission by means of aluminum soft-center rails in underground and suburban railways. Freidhofer, H.; Mier, G. *Elektr. Bahnen;* 47: No. 1, 157-159(1976). (In German).

Aluminum soft-center rails with polished stainless-steel surfaces are now available as an alternative to the conventional soft-center rails. The production of these rails is described, and their technical and economic advantages are outlined.

HYBRID SYSTEMS

REFER ALSO TO CITATION(S) 33315, 33347, 33359

33357 (CONF-771037—, pp 52-67) **Organic Rankine bottoming cycle for long haul diesel trucks.** Raymond, R. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The major portion of the waste energy in an internal combustion engine is associated with the exhaust gases,. Since this energy must be recovered by cooling the exhaust gases, the average temperature available for use in the waste heat recovery process is quite low. The organic Rankine bottoming cycle, due to its relatively high cycle efficiency at moderate peak cycle temperatures of 550°F to 650°F, offers the best potential for converting this energy to useable shaft power. Proof-of-concept tests using a diesel-powered bus are described.

33358 Device for storing mechanical energy, especially in sporting motor vehicles, e.g. go-carts etc. Emmer, R.J. German(FRG) Patent 2,552,906/A/. 2 Jun 1977. 9p. (In German).

The patent describes a device for storing the breaking energy of a vehicle. The breaking energy is converted into the rotational energy of a flywheel. When accelerating the vehicle, the energy is used again by means of a gear transmission.

FLYWHEEL PROPULSION

REFER ALSO TO CITATION(S) 33347, 33353

VEHICLE DESIGN FACTORS

REFER ALSO TO CITATION(S) 33347

33359 (UCRL—52303(Vol.1)) **Energy storage systems for automobile propulsion. Volume 1. Overview and findings.** Behrin, E.; Bolger, J.; Hudson, C.L.; O'Connell, L.G.; Rubin, B.; Schwartz, M.W.; Waide, C.H.; Walsh, W.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1977. Contract W-7405-ENG-48. 56p. Dep. NTIS, PC A04/MF A01.

A technical analysis of energy storage devices and energy storage power systems for automobiles was performed. The goal was to determine which devices and power systems are most likely to provide credible alternatives to current automotive propulsion systems between now and the year 2000. This work results from a 15-month study undertaken by 4 national laboratories, 8 consulting firms, and over 50 individuals. Study panels examined electrochemical, mechanical, and chemical/thermal storage devices and selected the most promising ones. The panels then identified the research and development tasks necessary to successful development, determined the relative likelihood of overcoming technical barriers, and assessed the probable performance characteristics of future production devices. The key characteristics sought for each projected device were specific energy and specific peak power. For batteries, the relationship between specific power and specific energy was also determined. Since projected characteristics of future storage devices are uncertain, decision analysis techniques were used to project values both as a function of time and as a function of confidence level. Costs of the storage devices were also forecast. From a large number of candidate storage devices, the study panels selected seven batteries, three mechanical devices, three hydrogen storage devices and one thermal energy storage device for detailed evaluation. Various automotive power systems incorporating the selected energy storage devices were then analyzed.

33360 Decentralized control of automated transportation systems via cellular-flow coordination. Tong, Y.M.; Morse, A.S. (Yale Univ., New Haven). pp 291-296 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

A Personalized Automated Transportation (PAT) system consists fundamentally of a set of stations interconnected by means of a network of dedicated guideways on which personalized (i.e., "small") vehicles travel under computer control. Such systems are intended to provide users with either scheduled or demand responsive service from station of origin to station of destination. The main components of a flow-coordinated strategy based on the concept of a cellular flow are outlined; and how this concept together with flow-coordination enable the decentralization of the controls regulating vehicle departures from stations and vehicle maneuvering at merges is explained. Explicit conditions are developed for determining when cellular vehicle flows are mergible, and an algorithm is presented for merging those flows which are. The minimum station capacity required to accommodate any cellular vehicle flow from a prespecified class, is calculated, and the rules required for stable station operation are discussed. A systematic procedure is developed for adjusting nominal travel times along guideways so as to attain a network on which correctly phased cellular flows can exist.

33361 Decentralized controls in real-time traffic systems. Chu, K.C. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). pp 1030-1033 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

A discussion is given of some ideas on decentralized control which would be particularly suitable for large systems, such as those arising in transportation problems. The main idea of decentralization is to partition the systems to be controlled into a set of smaller subsystems. Each subsystem is handled by a local controller which may have some weak interactions with the local controllers in other subsystems. These local controllers only receive information from neighboring environments and execute control commands for their own subsystem. Two examples of large transportation problems are described. Difficulties are discussed and certain new solution techniques are presented.

ENGINE-TRANSMISSION MATCHING

33362 (CONF-771037—, pp 40-51) **DOE/GSA microfleet evaluation of the Morse control speed accessory drive.** C. Wollard. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Automotive accessory drives have been traditionally avoided as excessively cumbersome and expensive. With the advent of mandatory fuel economy standards and higher gasoline costs, however, their application assumes increased economic feasibility. A discussion is given of a compact, mechanical device offering significant fuel economy savings. By limiting accessories speeds and, therefore, lowering parasitic horsepower losses, improvements in overall vehicle fuel economy are attained. Test results show maximum savings of 8 to 13%. An additional benefit is increased accessory life due to the smaller speed range encountered when used with the accessory drive. Operation, durability, and cost are discussed.

33363 (CONF-771037—, pp 73-93) **Hydro-mechanical transmission development for passenger car fuel economy improvement.** Huntley, P. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A Continuously Variable Transmission (CVT) is being developed for application to automobiles. The transmission is of the hydromechanical type, in which the power is split between a gear train and a speed-changing component consisting of a variable displacement hydrostatic pump and motor. Current development is focused on application of the transmission to a spark-ignition engine and compact automobile in the 3500 pound inertial weight class. It is

the purpose of the CVT to control the engine speed so as to maximize engine efficiency and thereby to improve fuel economy without incurring unacceptable penalties in emissions, driveability, or vehicle cost. In-vehicle transmission testing has proceeded far enough to confirm the availability of a 20% fuel economy improvement as predicted at the outset of this project. Test data for fuel economy, noise reduction, and exhaust gases (HC, CO, and NO/sub x/) are presented and discussed.

33364 (CONF-771037—, pp 94-101) **Demonstration of hydraulic module for an automotive hydromechanical transmission.** Lewis, P. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A novel construction of a hydrostatic module arranged in a tandem axial relationship with output planetary gearing is described. The modular hydrostatic construction provides direct connection to the engine input, and the gearing permits effective noise isolation and has minimum structural requirements. The configuration is attractive in that it uses a proven control system, conventional automotive design, and is compatible in size (envelope), weight, and cost with current transmissions. In this type of transmission, the single most critical component is the hydraulic unit since the losses are the major factor in determining transmission efficiency. The 100 hp module performance exceeded predictions, and typical data are presented. Typical operation curves are shown, and a schematic of the control system is given. The advantages associated with this CVT are listed.

ENGINE SYSTEM

REFER ALSO TO CITATION(S) 33327, 33331, 33335, 33337, 33346, 33387, 33388, 33389, 33394

33365 (CONF-771037—, pp 17-27) **Review of JPL Automotive Technology Status and Projections (ATSP) Project.** Dowdy, M.W. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The general objective of the ATSP Project is to make a continuing assessment of current automotive technology development programs and of the prospects for new concepts. The study embraces alternative engines, advanced powertrain components, and related energy-conserving vehicle modifications which could be implemented by the end of this century. Vehicle-level projections of the fuel economy and emissions potential of alternative power systems are key elements of this assessment. Alternative engines include Stirling engines, gas turbines, and Otto cycle engines.

33366 (CONF-771037—, pp 101-124) **Improving automobile fuel economy with accessory drives.** Lefferts, C. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A variable ratio belt accessory drive was developed, and it has demonstrated the performance and fuel economy potential of the constant speed principle. EPA composite driving cycle fuel economy was improved by 4.8%. Installation of the drive system permitted cost-effective accessory array redesign and improved load matching. Vehicle and accessory performance emissions, noise, and accessory life were also improved. Advanced air conditioning systems and hybrid drives, included combined and bottoming Rankine cycle systems, are described, and fuel economy data are presented for the various systems.

33367 (CONF-771037—, pp 129-143) **Status of the Chrysler Upgraded Gas Turbine Engine Program.** Wagner, C.E. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The program described is currently utilizing five engines. Three are being used in test cells for engine development, two at Chrysler and one at NASA; and two are installed in vehicles. Although no formal endurance effort has been undertaken, 600 hours of accumulated testing have revealed no significant mechanical problems. A corrective development program was extended to mid-1978 to allow for design modification of the turbomachinery. Constraints were eased to allow designs which should eliminate the present 25% power shortfall. Current efforts in the corrective development program involve: compressor efficiency; compressor turbine efficiency; power turbine efficiency; turbine section revisions; ribbed wheel windage losses; and regenerator mass flow distribution.

33368 (CONF-771037—, pp 143-149) **Lewis Research Center support of Chrysler Upgraded Engine Program.** Warren, E.L. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Lewis Research Center is supporting the Chrysler Upgraded Engine Program in many areas. A summary is given of one of those areas—the engine test work being done at Lewis. The Center's advanced engine facilities, instrumentation, and on-line computer capabilities are being used to support the Chrysler program. Running of the Upgraded Engine has indicated that, although the engine is mechanically sound, it is deficient in power. Recent modifications and corrective action have improved this, but there is still more work needed to reach the design goal. The test cell, instrumentation, current status, and future activities are discussed.

33369 (CONF-771037—, pp 149-164) **Improved Heavy Duty Gas Turbine Engine Program.** Helms, H.E.; Rockwood, F.A. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The gas turbine engine program described was initiated in 1976 with a study and initiation of work on ceramic components for testing in a baseline engine (for initial ceramic regenerator disk chemical stability evaluation) and in the initial engine purchased by the program (Engine C-1). The study was conducted to establish a viable Phase II program which could result in demonstration of ceramic components by 1981 (stretched to 1982) with significant test stand engine hours and with vehicle demonstrations using ceramic components. A discussion is given of: ceramic components; the initial ceramic test engine; burner and cascade test rig; ceramic parts inspection; ceramic gasifier turbine nozzle vanes; ceramic gasifier turbine stationary tip shroud; ceramic tip shroud; regenerator performance; hub-drive aluminum-silicate regenerator discs; and rim drive aluminum-silicate regenerator discs.

33370 (CONF-771037—, pp 165-174) **Status of Ford regenerator systems development.** Rahnke, C.S. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

In 1974, the Alternate Automotive Power Systems Division of EPA joined Ford Motor Company in a joint program to develop chemically resistant ceramic heat exchangers for use in turbine and Stirling engines and waste heat recovery systems. The program was transferred to the newly formed ERDA in 1975 and is now under the technical direction of NASA's Lewis Research Center with program direction from DOE. A specific objective of this program is the demonstration of a regenerator B_{10} life of 10,000 hours at 800°C (1472°F). The eight major tasks in the current NASA/Ford Program are listed. The presentation given is confined largely to a description of the test results obtained in the more important first two tasks: (1) engine tests at 800°C; and (2) engine tests at 1000°C. Data accumulated in the last six months continues to show that two materials, AS and MAS, have the potential of achieving the program objective of a B_{10} life 10,000 hours at 800°C (1472°F). To date, eight AS cores have accumulated over 4000 hours with three accumulating over 5000 hours. None of these cores show any serious signs of chemical attack damage.

33371 (CONF-771037—, pp 174-194) **Development of compliant foil bearings for automotive gas turbines.** Gray, S. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Mechanical Technology Incorporated (MTI) is under contract to design, test, develop, and deliver Hydresil compliant foil air bearings for the turbine end of the gas generator in the Chrysler gas turbine. A 1-$\frac{1}{2}$ inch diameter bearing was developed and is being used in the engine program at 60,000 rpm and temperatures of 500 to 600°F; currently limited developmental work is continuing at MTI in which the main emphasis is on the long-term reliability aspects of the bearing-rotor system and on delivery of engine bearings. A discussion is presented on recent bearing related work of interest.

33372 (CONF-771037—, pp 194-208) **Fabrication and testing of silicon nitride turbine rotors.** Harstock, D.L. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

While there are many complex shaped ceramic components in a 2500°F engine, the most complex and highly stressed component is the duo-density turbine rotor. The high strength of hot-pressed silicon nitride is used in the hub region where stresses are highest, but temperatures are moderate, and, therefore, creep resulting from the use of a magnesium densification additive is minimized. The blade ring is made from reaction bonded silicon nitride, which can be formed into complex airfoil shapes by injection molding or slip casting. Although the reaction bonded material is of lower density and, thus, lower strength, it is adequate for the turbine blades since stress levels in this region are lower than in the hub, and particularly

since the creep resistance of the reaction bonded material is superior, at high temperature, to that of the hot-pressed silicon nitride, mainly due to higher chemical purity as densification additives are not necessary. The hub is formed and bonded to the blade ring in one hot-pressing operation. During the last year, significant progress was made in injection molding flaw free blade rings and in eliminating damage to the blade ring during the hot-pressing operation.

33373 (CONF-771037—, pp 208-224) **Review of durability testing of structural ceramics.** Katz, R.N. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

During the past year, AMMRC has carried out a ceramic materials research program under an ERDA-TEC/AMMRC Interagency Agreement. Work has focused on three tasks: Task I-development of sinterable Si_3N_4; Task II-proof testing methodology; and Task III-durability testing of structural ceramics. These tasks address key issues identified in previous assessments of ceramic materials technology required for future vehicular engine programs. Accordingly, this work is being closely coordinated with NASA-Lewis who, as project managers, have responsibility for the DOE-TEC Gas Turbine Program. The presentation given highlights progress to date on Task III-durability testing of structural ceramics. The status of Tasks I and II are very briefly reviewed.

33374 (CONF-771037—, pp 224-225) **Heat exchanger materials based on lithium and magnesium aluminum silicates.** McCreight, L.R. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The purpose of the program described is to develop a ceramic material with appropriate physical and chemical properties suitable for application as a construction material for a heat exchanger in a vehicular gas turbine. The major requirements are low thermal expansion between ambient and 1000°C and the ability to operate at least for short times at temperatures up to 1100°C. Program status and results are briefly discussed.

33375 (CONF-771037—, pp 225-238) **Improved heat exchanger materials.** Kormanyos, K. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The purpose of the program described is to develop a ceramic material with physical and chemical properties suitable for a heat exchanger in a vehicular gas turbine. The major thrust of the program is toward improved resistance to chemical attack by sulfuric acid and sodium salts. The development materials must, however, exhibit low thermal expansion between ambient and 1000°C and the ability to operate at least for short times at temperatures up to 1100°C. The results of thermal cycling and corrosion resistance tests are presented for several materials.

33376 (CONF-771037—, pp 238-240) **Aluminous keatite as a regenerator material.** Lanning, J.G. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Some comparative data on aluminous keatite material are presented to indicate the status of engine testing at Ford and Detroit Diesel Allison (DDA) with this advanced material. The key core-material properties of the heavy walled T20-38 structure are shown at 0 hours and after 6935 hours of engine testing. The present program is to improve the T14-20 strength so that higher thermal performance at part load can be achieved.

33377 (CONF-771037—, pp 258-267) **Evaluation of reciprocating seals for stirling cycle engine application.** Waterman, A.W. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The program described for development of rod seals for a Stirling engine is in the design stage. The designs for the test system and one of the two seal retention fixtures were completed. The two seal configurations to be tested were selected and the selection approved by NASA. Work will proceed on completing the design of the second test fixture and initiating procurement and fabrication of parts as rapidly as NASA's approval to proceed is obtained. Testing will begin in the first few months of 1978 to determine friction, leakage, and wear characteristics of the seals selected for evaluation.

33378 (CONF-771037—, pp 274-286) **Survey of Stirling engine analytical design methods.** Martini, W.R. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A Stirling engine design manual will be produced and distributed as a government report. In this manual the information available in the literature on all aspects of Stirling engines will be organized and evaluated. Particularly the information needed to design a Stirling engine for a particular application will be evaluated and organized for convenient use by the designer. A summary is given which explains the essential character of a Stirling engine and gives an appreciation of the three orders of Stirling engine design methods.

33379 (CONF-771037—, pp 286-303) **Thermal energy storage/heat engine for highway vehicle propulsion.** Folsom, L.R. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The feasibility of the thermal energy storage/heat engine concept as an energy conversion system has been demonstrated. The effectiveness of this system as an alternative to storage battery/electric motor for highway vehicle propulsion has not been determined. The on-going program described involves system studies to assess the economic and technical feasibility of thermal energy storage (TES) for highway vehicle application. At this point in time, the program concerns only the TES System, namely, the thermal storage, thermal insulation, heat transport devices, heat delivery controls, and the interface between the thermal storage and the thermal recharge system. The output heat transfer surface of the TES System is the input heat transfer surface of the heat engine. The heat engine is not a part of the TES Program. The TES total energy and power levels appropriate for a compact vehicle/heat engine/power train combination are calculated on a consistent basis.

33380 Transistorized ignition system for internal combustion engines, in particular for vehicles. Mieras, L.F.; Skay, F. (to Ford-Werke A.G., Koeln (Germany, F.R.)). German(FRG) Patent 1,539,198/C/. 12 May 1977. 15p. (In German).

The invention concerns an ignition system for motor vehicles with solid state control of the power transistor switching the primary current of the ignition coil. A pulse generator driven by the engine is used for this, whose voltage pulses control the switching on of the power transistor and increase in a certain ratio to the engine speed. This ensures that the closing angle, i.e. the mechanical angle of rotation which the machine passes through while loading the ignition coil with mechanical energy, is automatically changed so that for low speeds it is just sufficient for certain ignition, but increases with increasing speed, so that the required ignition energy is always available. At low speeds one avoids charging current flowing through the primary winding of the ignition coil for longer than necessary and thus wasting electrical energy.

33381 Charged internal combustion engine. Dorsch, H. (to Porsche (F.) A.G., Stuttgart (Germany, F.R.)). German(FRG) Patent 2,541,371/A/. 24 Mar 1977. 7p. (In German).

The invention pertains to a charged internal combustion engine with a waste gas turbo-supercharger consisting of a supercharger and a waste-gas turbine. A secondary air pump in combination with an afterburner ensures afterburning of the waste gases, so that pollutants are reduced while the power of the waste-gas turbine is optimized for all operational states of the internal combustion engine. Detailed construction plans are given.

33382 Investigation of fuel economy potential of four 1977 model vehicles. Bechtold, R.L.; Fleming, R.D. Warrendale, PA; Society of Automotive Engineers (1977). 10p. (CONF-7709103—1).

From Passenger car meeting; Detroit, MI, USA (26 Sep 1977).

A vehicle testing program was conducted to determine the inherent fuel economy potential of current (1977) technology engines given freedom to optimize engine adjustment for best fuel economy with no constraint on engine-out emissions. The average city/highway fuel economy of four car models with optimized air-fuel ratio and spark timing was improved by 4.1% as compared to the fuel economy of the baseline values found for the vehicles with air-fuel ratio and spark timing at manufacturer's specifications.

33383 Stalled. Reitze, A.W. Jr. (George Washington Univ., Washington, DC). *Environment;* **19**: No. 6, 39-41(1977).

The Federal Ergy Administration has called for a $150 million-per year investment in automotive research to develop propulsion systems based on fuels other than petroleum. To date reliance has been placed on the auto industry. Most basic research either is government-funded or it does not take place. More research needs to be encouraged for research on alternative fuels, combustion theory, heat transfer, and materials, particularly those designed for high-temperature uses. Funding levels for the Alternative Automotive Power Systems program have been $12.3 million in 1974, $7.2 million in 1975, and about $10 million in 1976.

33384 Multilevel distributed system concept for computerized traffic-control applications. Lord, J.C. (Honeywell, Inc., Hopkins,

MN); Kumar, K.S.P. pp 1034-1037 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

Most computerized traffic control systems that are now operational use a central computer to perform virtually all data processing tasks. These systems operate satisfactorily, but it is believed that this system design approach is now stretched to its limit of practical capability. The recent availability of economical microprocessors and their successful application to traffic signal controllers suggests that investigations should be conducted into the formulation of traffic control system concepts that make full use of microprocessor capabilities and thereby identify improved systems for future applications, particularly those that relate to the concept of traffic management systems that is currently in favor. A description is given of a Multilevel Distributed System (MLDS) concept designed to meet future traffic control and traffic management system requirements as currently envisioned.

33385 **Comments on the engine-control problem.** Cassidy, J.F. (General Motors Research Labs., Warren, MI). pp 1038-1042 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

Today the automobile industry is facing unprecedented technical challenges in its attempts to meet the severe and conflicting demands of improved fuel economy and exhaust emission performance. Part of the solution to these problems resides in developing improved engine controls for such variables as air-fuel ratio, ignition timing, and exhaust gas recirculation. The engine control problem is defined in terms familiar to control systems specialists, and the structure of a solution is suggested. This problem is quite complex and at worst is nonlinear, time varying, and stochastic as well as involving multiple input and output variables. In view of the above factors, as well as the fundamental trade-off between fuel and exhaust emissions, and environmental and system parameter variations, the use of closed loop optimal and/or adaptive controllers is proposed. Improved sensor and actuator technology as well as adequate mathematical models are necessary to produce a solution of this difficult control problem.

33386 **Traffic system simulator: educational aspects of student design projects.** Falkenburg, D.R.; Evans, D.H. (Oakland Univ., Rochester, MI). pp 1155-1158 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

The Traffic Simulator is a small-scale model roadway on which vehicles are guided under computer control. A discussion is given of a prototype design for the simulator which has evolved through a number of coordinated student design projects.

WEIGHT

REFER ALSO TO CITATION(S) 33365

EMISSION CONTROL

REFER ALSO TO CITATION(S) 33347, 33381, 33715, 33716

NITROGEN OXIDES

REFER ALSO TO CITATION(S) 33318, 33321, 33322, 33323, 33324, 33325, 33327, 33328, 33329, 33330, 33331, 33332, 33334, 33335, 33337, 33345, 33363, 33382, 33385, 33394

33387 (DOT-TSC-OST—77-48) **Performance characteristics of automotive engines in the United States: Report No. 8, Mitsubishi model 6DS7 diesel engine.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. 35p. Dep. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of the Mitsubishi Model 6DS7 diesel engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, oxides of nitrogen, and smoke) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

33388 (DOT-TSC-OST—77-50) **Performance characteristics of automotive engines in the United States: Report No. 10, Chevrolet (1975) 250 CID 1-bbl engine.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. 42p. Dep. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Chevrolet 250-CID, 1-bbl engine to determine fuel consumption and emissions (hydrocarbons, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristics data required as input for engineering calculations involving ground transportation.

33389 (DOT-TSC-OST—77-51) **Performance characteristics of automotive engines in the United States: Report No. 11, Chrysler (1975) 318-CID 2-bbl engine.** Marshall, W.F.; Stamper, K.R. (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). Aug 1977. 43p. Dep. NTIS, PC A03/MF A01.

Experimental data were obtained in dynamometer tests of a 1975 Chrysler 318-CID, 2-bbl engine to determine fuel consumption and emissions (hydrocarbon, carbon monoxide, and oxides of nitrogen) at steady-state engine operating modes. The objective of the program is to obtain engine performance data for estimating emissions and fuel economy for varied engine service and duty. The intent of the work is to provide basic engine characteristic data required as input for engineering calculations involving ground transportation.

33390 **Retaining gaseous pollutants in electrostatic filters.** Klumpp, D. *Staub-Reinhalt. Luft;* **37**: No. 7, 257-259(Jul 1977). (In German).

This paper describes chemical reactions of electric gas discharges in electrostatic precipitators with emphasis on the carbomonoxide-dioxide process. Three different types of precipitators are investigated. The reduction of CO depends on mechanical and electrical filter parameters as is shown for various synthetic mixtures of CO and compressed air. However, depending on electrode configuration, toxic nitrogen oxides may be produced. Experimental results of a precipitator with pin electrodes are presented, demonstrating carbon monoxide reduction up to 45%.

CARBON MONOXIDE

REFER ALSO TO CITATION(S) 33318, 33321, 33323, 33327, 33329, 33331, 33332, 33334, 33335, 33337, 33345, 33363, 33382, 33385, 33387, 33388, 33389, 33390

HYDROCARBONS

REFER ALSO TO CITATION(S) 33321, 33324, 33327, 33328, 33329, 33331, 33332, 33334, 33335, 33337, 33345, 33363, 33382, 33385, 33387, 33388, 33389

PARTICULATES

REFER ALSO TO CITATION(S) 33387

ALTERNATIVE FUELS

REFER ALSO TO CITATION(S) 33320, 33322, 33337, 33383

33391 (CONF-771037—, pp 305) **Perspective and introductory remarks.** Ecklund, E.E. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A brief historical review is given of a study program on alternative transportation fuels is given. The current program is being carried out at Lawrence Livermore Laboratories. (PMA)

33392 (CONF-771037—, pp 311-333) **Identification of probable automotive fuels composition.** Russel, J.A. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Southwest Research Institute, with Sohio Research and Engineering (Cleveland) and Cameron Engineers (Denver), is about to complete a 15-month study to develop methodology to be utilized in

projecting most probable compositions of hydrocarbon and methanol automotive fuels, using domestic nonpetroleum resources (oil shale and coal) in their manufacture. Methodology has been established; compositional factors are critically contingent upon syncrude conversion process parameters which require further development and definition. If the emerging syncrudes-synfuels industry develops at currently forseeable rates, such syncrudes will be blended with petroleum crudes in such a manner as to have no impact on conventional automotive fuels composition.

33393 (CONF-771037—, pp 334-341) **Automotive hydrogen storage with magnesium hydride.** Rohy, D.A. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Experimental data were obtained which show that modified Mg—Ni alloys offer the greatest potential for on-board hydrogen fuel storage for automobiles. Dissociation temperature at one atmosphere hydrogen pressure is reduced to 204°C for an alloy of Mg, Ni, Cu, Si, and Y from 302°C for $Mg_{0.9}Ni_{0.1}H$/sub x/. Nickel content has been reduced to 24% from 55% in Mg_2NiH/sub x/. Dissociation temperatures as low as 223°C were achieved with alloys containing 10% nickel. Dissociation pressure, hydrogen capacity, kinetics, and safety are other hydride characteristics considered. Practical considerations of the cost, size, weight, fueling, and storage period of a hydride system with the energy equivalent of 20 gallons of gasoline are reviewed. A four-phase study of magnesium alloy hydrides is in progress. Some of the key features of this system are reviewed.

33394 (CONF-771037—, pp 341-350) **Data for design of a hydrogen engine: a progress report.** Adt, R.; Swain, M.R. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A program to develop a data base for hydrogen engine design and also hydrogen fuel system design is described. A secondary objective is to try to rationalize or make sense out of existing hydrogen engine data. Much of the existing data is incoherent. Hydrogen engines are classified into two main categories: (1) pre-IVC engines (Hydrogen introduced into the cylinder before closing the intake valve); and (2) post-IVC engines (Hydrogen introduced into the cylinder after intake valve is closed). These categories and the variations within these categories are tabulated. It is emphasized that no particular design or mode of operation is being recommended at this time. The data base is still being generated. A small fraction of the data generated to date are presented, including thermal efficiency and nitric oxide emissions data. Critical hardware items are discussed.

33395 (CONF-771037—, pp 350-352) **Alternative fuels for intercity trucking systems.** Escher, W.J.D. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

A preliminary look is given at a new sector for the alternative fuels program. The project is only three months underway. It is supported by the DOE Alternative Fuels Utilization Branch of Conservation (near-term and mid-term fuel systems) and the Ryder program in Transportation at University of Miami (for far term fuel systems). Focus is on the large tractor trailor units, GVW7 26,000 lbs. An outline is given of project objectives, work requirements, preliminary alternative fuels list, transition problems, and preliminary observations.

33396 (CONF-771037—, pp 352-362) **Non-petroleum fuels and compatible engines: 1977 BERC up-date report.** Hurn, R.W. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

Experimental work is being done with fuels derived from non-petroleum sources and also with fuel synthesized from traditional hydrocarbon sources to have properties that are foreseen for alternative fuels. These include methanol, methanol-gasoline blends, and coal and shale derived fuels. These fuels are being studied in engines that are judged to be plausible candidates for use with fuels of the synfuels era. Such engines focus upon evolutionary leanburn versions of traditional gasoline and diesel engines including stratified-charge designs. The Stirling also is included as a possible contender in the continuous combustion category. Results indicate no serious problems in realizing good mutual accommodation of evolving engines and synthetic fuels. However, the evidence is that, for best efficiency, combustion systems must be designed and adjusted for specific fuel properties.

33397 **New fuels for road transport vehicles.** Garrett, K. *S. Afr. Mech. Eng.;* **27**: No. 8, 254-256(Aug 1977).

Given a stratified charge engine that will tolerate a wide range of fuels, the prospects for liquid fuels obtained from coal are greatly improved. The thermal efficiency of a carburetted stratified charge engine is about 16.3 percent--higher than that of a conventional spark ignition engine--while that of an injected stratified charge engine is approximately 17.2 percent--the same as that of a conventional diesel unit. Secondly, because the fuel properties demanded for either type of stratified charge unit are not so stringent as for their conventional counterparts, processing from coal can be effected at an efficiency of at least 50 percent.

MATERIALS

33398 (DOE/ET—0006) **Survey and analysis of selected topics within the Energy Research and Development Administration's (ERDA) materials research and development programs.** (Department of Energy, Washington, D.C. (USA). ERDA Materials Coordinating Committee; Oak Ridge National Lab., Tenn. (USA)). Jan 1978. Contract W-7405-ENG-26. 137p. Dep. NTIS, PC A07/MF A01.

A review of ERDA contracts current in 1977 is presented for: structural alloy development; nondestructive testing; structural ceramics development; general corrosion; erosion and wear; and effects of hydrogen on materials. (GHT)

33399 (SAND—78-0354C) **Materials problems in solar, nuclear, and storage of energy.** Claassen, R.S. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1978. Contract EY-76-C-04-0789. 29p. (CONF-780222—1). NTIS, MF A01.

From 5. energy technology conference; Washington, DC, USA (27 Feb 1978).

Portions of document are illegible.

Developing energy technologies place increasing demand on material performance and in some cases exceed known material capabilities. Material choices in solar systems are dominated by cost. Distributed collectors and the central receiver illustrate practical problems. The demand for absolute safety in nuclear power requires a depth of understanding and level of knowledge about materials unachieved in previous engineering systems. Problems in water-cooled and breeder reactors emphasize the point. Fusion reactors will push far beyond our present knowledge of material response and behavior. Within limits, energy storage is practical today but present technologies such as batteries are being pushed hard and new schemes such as superconducting solenoids and thermochemical storage are under intense study.

METALS AND ALLOYS

REFER ALSO TO CITATION(S) 32573, 32574

33400 (ORNL—5380) **Mechanical properties test data for structural materials. Quarterly progress report for period ending January 31, 1978.** Hill, M.R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 383p. .

Collected results of all structural materials mechanical properties test programs sponsored by the Reactor Research and Technology and the Nuclear Power Development divisions of the Department of Energy during the period from Oct. 31, 1977 to Jan. 31, 1978 are presented. (GHT)

33401 (RFP—2664) **Summary of beryllium specifications.** Corle, R.R. (Atomics International Div., Golden, Colo. (USA). Rocky Flats Plant). 17 Feb 1978. Contract EY-76-C-04-353. 19p. Dep. NTIS, PC A02/MF A01.

This report summarizes and compares the main beryllium properties included in producer, Department of Energy (formerly ERDA) facility, and government specifications. These data are tabulated in a sequence established primarily by increasing purity and secondarily by increasing tensile properties. Comments on formability and weldability are also included.

33402 (UCRL—80723) **Electron beam welding cavity temperature distributions in pure metals and alloys.** Schauer, D.A.; Giedt, W.H.; Shintaku, S.M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1978. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

From 59. AWS annual meeting; New Orleans, LA, USA (3 Apr 1978).

The adaption of a narrow band infrared radiation pyrometer for measurements of the surface temperature variation in an electron beam welding cavity is described. Results are presented for welds in aluminum 1100, 2024, 5083, 6061, and 7075; steel 304, 20-6-9, and HY-180, and tantalum. Average peak temperatures for aluminum decreased from a maximum of 1900°C for the 1100 alloy to 1250°C

for the 5083 alloy and 1080°C for the 7075 alloy; for steel 304, 20-6-9 and HY-180 peak values were 2100, 1820, and 2290°C. This change was shown to be due to the presence of relatively volatile constituents in the alloys. It was also found that for a specific material the peak temperature did not vary significantly with penetration depth.

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 33305

33403 (COO—3084/57) **Limits to ductility set by plastic flow localization.** Needleman, A.; Rice, J.R. (Brown Univ., Providence, R.I. (USA). Div. of Engineering). Nov 1977. Contract EY-76-S-02-3084. 56p. (CONF-7710125—1). Dep. NTIS, PC A04/MF A01.

From Symposium on mechanics of sheet metal forming; Warren, MI, USA (17 Oct 1977).

The theory of strain localization is reviewed with reference both to local necking in sheet metal forming processes and to more general three dimensional shear band localizations that sometimes mark the onset of ductile rupture. Both bifurcation behavior and the growth of initial imperfections are considered. In addition to analyses based on classical Mises-like constitutive laws, approaches to localization based on constitutive models that may more accurately model processes of slip and progressive rupturing on the microscale in structural alloys are discussed. Among these non-classical constitutive features are the destabilizing roles of yield surface vertices and of non-normality effects, arising, for example, from slight pressure sensitivity of yield. Analyses based on a constitutive model of a progressively cavitating dilational plastic material which is intended to model the process of ductile void growth in metals are also discussed. A variety of numerical results are presented. In the context of the three dimensional theory of localization, it is shown that a simple vertex model predicts ratios of ductility in plane strain tension to ductility in axisymmetric tension qualitatively consistent with experiment, and the destabilizing influence of a hydrostatic stress dependent void nucleation criterion is illustrated. In the sheet necking context, and focussing on positive biaxial stretching, it is shown that forming limit curves based on a simple vertex model and those based on a simple void growth model are qualitatively in accord, although attributing instability to very different physical mechanisms. These forming limit curves are compared with those obtained from the Mises material model and employing various material and geometric imperfections.

33404 (LBL—7347) **Powder metallurgical processing of magnetostrictive materials based on rare earth-iron intermetallic compounds.** Malekzadeh, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1978. Contract W-7405-ENG-48. 107p. Dep. NTIS, PC A06/MF A01.

Procedures are described for fabrication of high density rare earth-iron magnetostrictive compounds by powder metallurgical techniques. The fabrication involves a sequence of steps which includes preparing the pre-alloyed compounds, pulverizing them into a fine powder, compacting in suitable sizes and shapes, and sintering. Samples prepared by these procedures are carefully characterized by scanning electron microscopy, x-ray diffraction, dilatometry, and magnetic measurements. Process steps are found to exert important influences upon densities, microstructure and magnetic properties attained after densification. Investigations on a number of these process steps, including milling time and medium, sintering, and magnetic powder alignment are described.

33405 (LBL—7357) **Low alloy steels for thick wall pressure vessels. Yearly report, October 1, 1976—September 30, 1977.** Horn, R.M.; Parker, E.R.; Zackay, V.F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1977. Contract W-7405-ENG-48. 102p. Dep. NTIS, PC A06/MF A01.

A summary is presented of progress during the first year of a program to modify current ferrous alloys and develop new low-alloy steels that can be field-fabricated into large-diameter, thick-walled pressure vessels for commercial coal gasifiers. Determination of design criteria for the pressure vessel steels, incorporating information gained through review of the literature and gained through interaction with industry, national laboratory personnel, and research contractors is described. Work has been performed to verify that simulation techniques lead to good reproducibility. This work has required evaluating commercially-produced material and small ingot material. Primary program effort has been placed on carrying out studies in modified commercial alloy systems to direct scaled-up investigations. Transformation behavior, microstructural characterization and mechanical property assessment have been determined for several modified alloys. Emphasis has been placed on Mn-Mo-Ni steels, A533 types, and Cr-Mo steels, A-542-type. Initial compositions for complete thick-section characterization have been determined. Work on the third system, Ni-Cr-Mo steels (A543-type) has focused on embrittlement susceptibility, with composition modifications having been selected for studying this phenomenon. Work on eutectoid steels has been undertaken on an associated fundamental studies program. These studies have been aimed at identifying useful alloy systems.

33406 (UCRL—13704) **Research and development of stabilized multifilamentary Nb_3Sn superconductors. Technical report, January 1, 1976—September 30, 1976.** Ormand, F.T. (Airco, Inc., Murray Hill, N.J. (USA). Central Research Labs.). 1976. Contract W-7405-ENG-48. 29p. Dep. NTIS, PC A03/MF A01.

The basic objectives of this work included: making additional test samples of 1000 A (at 12 T) conductor, scaling up the production of 3500 A conductor to larger billets, and improving the performance of 1000 A size conductor by utilizing 13.5 wt% tin-bronze rather than 10% bronze. Additional samples of 1000 A conductor were made successfully from a 51 mm diameter third-stage billet. This 1.68 x 5.00 mm conductor had a critical current of 1060 A at 12 T, 4.2 K and $10^{-13}\Omega$ m. A 101 mm diameter third-stage billet of 3500 A configuration was extruded, drawn, and reacted successfully to make 3.12 x 9.40 mm conductor. Current was 3600 A at 12 T, 4.2 K and $10^{-13}\Omega$ m. A 187 mm diameter third-stage billet of 3500 A configuration, packed with hexes from two scaled-up 152 mm diameter second-stage billets, was unsuccessful. Longitudinal cracks appeared in some portions of the second-stage extrusions during drawing. Multiple breaks were found in each of the tantalum barriers after drawing the third-stage extrusion. It is not yet clear whether these problems are attributable to impurities, or unfavorable metallurgical conditions in the tantalum or the bronze, or to scaling up to a larger size. First-, second- and third-stage billets containing 13.5 wt% tin-bronze were extruded and drawn to appropriate sizes. The 1.68 x 5.00 mm conductor was reacted to give a critical current of 1800 A at 12 T, 4.2 K and $10^{-13}\Omega$ m.

33407 (UCRL—80724) **Prediction of electron beam welding spiking tendency.** Schauer, D.A.; Geidt, W.H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1978. Contract W-7405-ENG-48. 33p. (CONF-780406—2). Dep. NTIS, PC A03/MF A01.

From 59. AWS annual meeting; New Orleans, LA, USA (3 Apr 1978).

On the basis of measured temperature distributions in electron beam welding cavities it is shown that the vapor pressure force dominates in the lower region and the surface tension in the upper region. The region where these two forces are approximately equal is unstable and the surface tension force causes inward flow of liquid metal which tends to form a projection. For a specific material this projection location was found to depend on cavity depth. By postulating that the formation of liquid metal projections at this location results in cavity instabilities, a physical model for predicting when spiking would occur was purposed. A procedure then developed for determining the spiking tendency for a specified material and set of weld parameters is described.

33408 **Dispersion strengthened ferritic alloy for use in liquid-metal fast breeder reactors (LMFBRS).** Fischer, J.J. (to International Nickel Co., Inc.). US Patent 4,075,010. 21 Feb 1978. Filed date 5 Feb 1976. 10p.

A dispersion-strengthened ferritic alloy is provided which has high-temperature strength and is readily fabricable at ambient temperatures, and which is useful as structural elements of liquid-metal fast breeder reactors. 4 tables.

33409 **Steel for nuclear applications.** Zorev, N.N.; Astafiev, A.A.; Loboda, A.S. US Patent 4,072,509. 7 Feb 1978. Filed date 5 Jan 1977. 6p.

A steel contains, in percent by weight, the following constituents: carbon from 0.13 to 0.18, silicon from 0.17 to 0.37, manganese from 0.30 to 0.60, chromium from 1.7 to 2.4, nickel from 1.0 to 1.5, molybdenum from 0.5 to 0.7, vanadium from 0.05 to 0.12, aluminium from 0.01 to 0.035, nitrogen from 0.05 to 0.012, copper from 0.11 to 0.20, arsenic from 0.0035 to 0.0055, iron and impurities, the balance. This steel is preferable for use in the manufacture of nuclear reactors. 1 table.

33410 **Method for preparing high transition temperature Nb_3Ge superconductors.** Newkirk, L.R.; Valencia, F.A. (to Energy Research and Development Administration). US Patent 4,054,686. 18 Oct 1977. Filed date 26 Jun 1975. 4p.

PAT-APPL-590,757.

Bulk coatings of Nb_3Ge superconductors having transition temperatures in excess of 20°K are readily formed by a chemical vapor deposition technique involving the coreduction of $NbCl_5$ and $GeCl_4$ in the presence of hydrogen. The $NbCl_5$ vapor may advantageously be formed quantitatively in the temperature range of about 250° to 260°C by the chlorination of Nb metal provided the partial pressure of the product $NbCl_5$ vapor is maintained at or below about 0.1 atm. 2 claims, 1 figure.

33411 (ORNL-tr—4579) **Technical studies and manufacture of rocket nozzles from high-melting materials and steel cladding of nozzles.** Kirner, K. (Bosch (R.) G.m.b.H., Gerlingen (Germany,

F.R.)). Aug 1976. Translation by J. Crabbs of BMFT-FB-W—76-11. 30p. Dep. NTIS, PC A03/MF A01.

Rocket nozzles made from copper or graphite used for high energy fuel tests were armored with tungsten by the plasma spray technique in order to achieve a longer life time. Also by the plasma spray technique, free standing nozzles were made of tungsten, molybdenum and the compound materials tungsten + copper and molybdenum + copper. The brittleness and the low ductility of these materials should be considered in handling but also in the design of nozzle components, which could be achieved in the final stage of this investigation. Because the test temperatures were high above the melting temperatures of the materials, even of the highest melting metals, only life times of a few seconds could be expected. Metallographic evaluations of failed armored nozzles as well as of sprayed free standing nozzles showed that melting and carbide formation had occurred in many cases.

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 34118

33412 (UCRL-Trans—11323) **Preparation of pure crystalline boron and measurement of its hardness.** Formstecher, M.; Ryskevic, E. Translated from *C. R. Hebd. Seances Acad. Sci.;* **221**: 747-749(12 Dec 1945). 6p. Dep. NTIS, PC A02/MF A01.

Synthesis of boron crystals is described. Hardness of the crystals was measured by the microscopic method of Hanemann and Bernhardt in which a small diamond pyramid, seated at the center of the microscope objective, bears on the polished surface of the test specimen under the effect of a known variable load. The hardness is calculated from the resulting indentation. (GHT)

MECHANICAL PROPERTIES

REFER ALSO TO CITATION(S) 33409, 33454, 33455

33413 (BNL-NUREG—23776) **Correlation of low-cycle and high-cycle fatigue data for solution-annealed incoloy-800.** Soo, P.; Chow, J.G.Y. (Brookhaven National Lab., Upton, N.Y. (USA)). 1978. Contract EY-76-C-02-0016. 6p. (CONF-780310—1). NTIS, MF A01.

From International conference on alloy 800; Petten, Netherlands (14 Mar 1978).

High-cycle data were generated on Materials Test System (MTS) closed-loop electrohydraulic fatigue machines operating in the push-pull sinusoidal-load waveform mode at a frequency of 40 Hz. All tests were in air on hourglass specimens which had a minimum diameter of 0.125 inch. Three Incoloy heats were evaluated and contained the following concentrations of carbon, titanium, and aluminum: Heat HH5556A—0.07% C, 0.42% Ti, 0.47% Al; Heat HH3113A—0.06% C, 0.39% Ti, 0.36% Al; and Heat HH7531A—0.03% C, 0.20% Ti, 0.10% Al. Data on the latter low-carbon heat are given for comparison only and were not included in the analysis.

33414 (LBL—6295) **Discussion: "toughness variations during the tempering of a plain carbon martensitic steel" by J.E. King, R.F. Smith and J.F. Knott. Retained austenite and transgranular tempered martensite embrittlement.** Rao, B.V.N.; Thomas, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1977. Contract W-7405-ENG-48. 12p. (CONF-770601—5). Dep. NTIS, PC A02/MF A01.

From 4. international conference on fracture; Waterloo, Canada (19 Jun 1977).

Discussion is presented to substantiate, clarify and reinterpret some of the results of the above authors for the existence and origin of tempered martensite embrittlement (TME) in relation to retained austenite, with reference to the experimental steels worked at LBL for the past several years.

33415 **Hydriding of Zr—13.5Nb—0.2Cr alloy under stress.** Mishima, Y.; Takahashi, N.; Arai, Y.; Ishino, S. (Tokyo Univ.). pp 7p, Paper 1E5 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Accelerated hydriding of Zr—13.5Nb—0.2Cr alloy in LiOH solution was performed under various bending stresses applied during the corrosion. Hydrogen pick-up, hydride orientation, stress relaxation, and change of spring properties were studied as a function of the applied stress. 2 figures, 2 tables.

33416 **Effect of purity, prestrain, and cooling rate on hydrogen strengthening in niobium single crystals.** Fournier, R.; Gibala, R. (Case Western Reserve Univ., Cleveland). pp 7p, Paper 1E6 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Hydrogen strengthening of niobium at approximately 77°K depends on purity, prestrain at 295°K, and cooling rate from 295°K. Increasing purity, prestrain and decreasing cooling rate reduce hydrogen strengthening. High-purity alloys exhibit hydride softening, a decrease in flow stress with increasing hydrogen content. 4 figures.

33417 **New phenomenon of the regulable hydrogen phase hardening of metals.** Goltsov. V.A.; Timofeev, N.I.; Machikina, I.Yu. (Donetsk Polytechnical Inst., USSR). pp 2p, Paper 1E7 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

On the example of palladium and its alloys a phenomenon discovered of regulable hydrogen phase hardening is studied. It is shown that during the thermocycling treatment the metal saturated by hydrogen is strengthened and peculiar structures arise with a wide spectrum of physicomechanical properties.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 32856, 33406, 33453, 34312

33418 (CONF-771127—15) **Magnetic susceptibility of $AnRe_2$ compounds.** Brodsky, M.B.; Trainor, R.J.; Aldred, A.T.; Sowers, C.H. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 9p. Dep. NTIS, PC A02/MF A01.

From 23. conference on magnetism and magnetic materials; Minneapolis, MN, USA (8 Nov 1977).

The compounds $AnRe_2$, where An = Th, U, Np, and Pu all have the $MgZn_2$-type hexagonal Laves phase structure. Measurements of their magnetic susceptibilities have been made from 2-300 K. Whereas $ThRe_2$, URe_2, and $PuRe_2$ have essentially temperature-independent susceptibilities, $NpRe_2$ is ferromagnetic with T/sub c/ = 47 K. The paramagnetic data for $NpRe_2$ follow a modified Curie-Weiss law, chi-che$_o$ = C/(T-THETA) from 60-230 K with THETA = 46.9 K and C equivalent to an effective moment, P/sub eff/ = 2.11 μ/sub B/. The ordered moment μ_o = 0.90 μ/sub B/ and the results are consistent with other actinide compounds having good local moment behavior. The electronic specific heat of URe_2 = 34 mJ/(mole-K^2) is large enough to indicate the possibility of spin-fluctuation behavior in this compound.

33419 (CONF-7709106—1) **Microscopic theory of charge density wave instability in $NbSe_2$.** Das, S.G.; Sinha, S.K.; Wakabayashi, N. (Argonne National Lab., Ill. (USA); Oak Ridge National Lab., Tenn. (USA)). Feb 1978. Contract W-7405-ENG-26. 13p. Dep. NTIS, MF A01.

From Conference on phonons; Paris, France (Sep 1977). Portions of document are illegible.

The microscopic theory of Sinha and Harmon for electronically driven lattice instabilities is used to explain the "Kohn-like" anomalies in the Σ_1 phonon branch and the observed incommensurate superlattice Bragg peak in 2H-$NbSe_2$, characteristic of the charge density wave at low temperatures in the neutron scattering experiments of Moncton et al. In accordance with the APW and LCAO band-structure calculations of Mattheiss of 2H-$NbSe_2$, we have assumed the presence of three narrow d bands of atomic symmetry xy, x^2-y^2 and $3z^2$-r^2 at the Fermi level. Thus the conduction-band wave function is represented by a linear combination of tight-binding Gaussian atomic orbitals with neglect of the variation of the radial wave function across the bands. The screened electron-ion interaction and the Coulomb energy of the charge fluctuation on the d shells of Nb atom is represented by a pseudopotential screened by the Lindhard dielectric function. The phonon Eigenvectors needed for estimating the electron-phonon interaction were calculated using a simple force constant model. In agreement with the experimental results, we have found that the phonon frequencies for the Σ_1 and Σ_3 branches are very strongly renormalized as one approaches the zone boundary. By introducing the electronic relaxation effects a central peak appears at the q vector of the instability and the actual phonon renormalization is partially suppressed. This explains the superlattice Bragg peaks observed at low temperatures and "Kohn-like" anomalies in the Σ_1 phonon branch of $NbSe_2$.

33420 (COO—2305-5) **Electron-dislocation interaction at low temperatures. Progress report.** (Connecticut Univ., Storrs (USA)). 1978. Contract EY-76-S-02-2305. 7p. Dep. NTIS, PC A02/MF A01.

The interaction of mobile dislocations with electrons in copper and copper alloys has shown that dislocation motion in copper, at low temperature, can be treated as an analog of an underdamped oscillator. We have also shown that the viscous drag on mobile dislocations in type II superconductors can be treated as an acoustic attenuation of an elastic wave.

33421 (LBL—6931) **Microstructure and magnetic properties.** Belli, Y.; Okada, M.; Thomas, G.; Homma, M.; Kaneko, H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.; Tohoku Univ., Sendai (Japan)). Dec 1977. Contract W-7405-ENG-48. 18p. (CONF-771127—13). Dep. NTIS, PC A02/MF A01.

From 23. conference on magnetism and magnetic materials; Minneapolis, MN, USA (8 Nov 1977).

The relationship between the microstructure and magnetic properties of heat treated Fe-23 wt percent Cr—15 wt percent Co—5 wt percent V has been studied by transmission electron microscopy and Lorentz microscopy. Three different heat treatments were adopted for the present investigations viz., (1) isothermal aging, (2) TMT (thermomagnetic treatment) + step-aging, (3) continuous cooling. It has been found that the magnetic properties of the alloy are very sensitive to the temperature of the thermomagnetic treatment. Step-aging gave the best magnetic properties, producing an elongated ferromagnetic phase, 300 A in diameter and 1200 A in length. Lorentz microscopy revealed domain walls and these lie within the Cr-rich phase and pinned by the Fe-rich phase in the isothermally aged alloy at 650°C. Magnetic domains of optimally step-aged alloy, 0.5 μm in width, are elongated along the direction of the applied magnetic field. The results suggest that the magnetic anisotropy is introduced parallel to the direction of the applied magnetic field during TMT and step-aging treatments.

33422 **Effect of third element additions on the properties of bronze processed Nb_3Sn.** Dew-Hughes, D. (Brookhaven National Lab., Upton, NY). *IEEE Trans. Magn.;* **13**: No. 1, 651-654(Jan 1977).

The effect of additions of Al, Sn or Zr to the Nb core, together with additions of Al, Ga or In to the bronze matrix, on the rate of layer growths and critical current density of Nb_3Sn formed by the bronze process has been studied. Small amounts of Al (1.25 wt%) in the core, separately or together with a few percent of Al in the matrix, replacing some of the Sn, increase the rate of growth of the Nb_3Sn layer. Larger quantities of Al (<2 wt %), of Ga or of In in the matrix decrease the rate of layer growth by more than can be accounted for by the concomitant reduction in Sn content. Low field critical current density is more dependent upon layer thickness and growth rate than upon composition. High field critical current density is directly related to the upper critical field.

33423 **Diffusion of hydrogen in solids and liquids.** Wach, S. (City of London Polytechnic, Eng.). pp 10p, Paper 1A1 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

Experimental data on diffusion in condensed media for hydrogen, and for other elements, may be rationalized by the replacement of the Wert—Zener—Le Claire equation with the alternative expression D = D/sub theta/ exp (Q/sub D//R theta - Q/sub D//RT). With D/sub theta/ = h/4πm and theta = hν/k, both these constants depend only on the diffusant. The rearranged logarithmic form of the equation offers an expression for the free energy, A, of an element A = R theta ln(D/D/sub theta/) = Q/sub D/ - (Q/sub D//T)theta. A reference state of A = 0 exists at T = theta and D = D/sub theta/. Similar considerations apply to entropy. A modified Nernst—Einstein equation for mobility, v, is given as v = zD/k theta - zD/kT. 2 figures, 2 tables.

33424 **Electrochemical method for measuring the permeation rate of pressurized gaseous hydrogen through a steel membrane: influence of the impurities content of the gas.** Clermont, R. (Univ. Paris sud Lab. de Metallurgie, Orsay, France); Aucouturier, M.; Brass, A.M.; Faudou, J.Y.; Guenot, R. pp 8p, Paper 1A2 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

An electrochemical method for measuring the permeation rate of gaseous hydrogen is applied to the study of the inhibitive influence of oxygen on hydrogen permeation. Results are discussed in terms of dynamic and delayed rupture of the steel under hydrogen pressure. 5 figures, 3 tables.

33425 **Permeation and diffusion of hydrogen and its isotopes in some metallic alloys.** Tison, P.; Broudeur, R.; Fidelle, J.P.; Hocheid, B. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel, France). pp 8p, Paper 1A4 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

The permeability to H isotopes of various Au-, Co-, Fe-, Ni-, and Pt-base alloys was determined in the temperature range 20 to 450°C. The influence of surface or internal trapping phenomena was elucidated, and the diffusion coefficients were computed whenever permitted by experimental conditions. 3 figures., 3 tables.

33426 **Diffusion coefficients of hydrogen in iron alloys at temperatures between 25 and 300°C.** Lange, K.W.; Loenig, H.J. (Technical Univ., Aachen). pp 7p, Paper 1A5 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

"True" diffusion coefficients of hydrogen in binary iron alloys containing Cr, Mn, Co, Ni, and S are determined between room temperature and about 300°C. Their dependencies on temperature and concentration are presented by mathematical functions. 8 figures.

33427 **Precipitation and trapping of hydrogen in copper.** Wampler, W.R.; Schober, T.; Lengeler, B. (IFF der KFA Juelich, Ger.). pp 5p, Paper 1B11 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

Resistivity and microscopy studies showed that hydrogen dissolved in Cu precipitates into bubbles at room temperature. The bubble growth is governed by hydrogen diffusion. Grain boundaries are the preferential nucleation sites. Hydrogen can be trapped by impurities between -130 and -50°C. 4 figures, 1 table.

33428 **Permeation of hydrogen through molybdenum from glow discharge plasma.** Sharapov, V.M.; Zakharov, A.P. (Inst. of Physical Chemistry, Moscow). pp 6p, Paper 1B12 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

The permeation of hydrogen from glow discharge plasma through molybdenum was investigated in the range of temperatures 300 to 800°C. It was found that below 450°C the hydrogen permeation is determined by migration of point defects. 4 figures.

33429 **Effect of sharp structure in the electronic density of states on the electron-phonon coupling in high T/sub c/ superconductors.** Fradin, F.Y. (Argonne National Lab., IL). *Ferroelectrics;* **16**: 285-287(1977).

The evidence for sharp structure in the electronic density of states N(epsilon) of certain classes of high T/sub c/ superconductors is based on the normal state temperature dependence of the spin susceptibility chi, electronic specific-heat coefficient γ, electrical resistivity rho, and nuclear spin-lattice relaxation rate $1/T_1$. Model calculations of chi, γ, rho, and T_1 in the rigid N(epsilon) approximation and of chi and γ for a temperature dependent N(epsilon) are presented for V_3Ga and V_3Si. The model calculations have been used to calculate the explicit temperature dependence of the electron mass enhancement and the renormalized electronic specific heat coefficient. The temperature dependence of the dielectric screening, which can have an important effect on renormalizing the phonon frequencies at low temperatures, is also discussed.

33430 **Single crystal elastic constants with inferences pertinent to vibrational behavior and superconductivity.** Smith, J.F. (Ames Lab., IA). *Ferroelectrics;* **16**: 95-98(1977).

Data are presented to show that indications of mode softening may be obtained from elasticity measurements. In the extreme limit where mode softening results in the vanishing of an elastic constant, phase instability ensues. Mode softening and superconductivity are interrelated, and unusual elastic behavior is often observed in superconductors. Such elastic behavior and superconductivity seem to arise from a common cause.

33431 **Interpretation of the thermodynamic properties of hydrogen in Pd—Ag alloys.** Oates, W.A.; Ramanathan, R. (Univ. of Newcastle, Australia). pp 8p, Paper 2A11 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The widely accepted model of Brodowsky [Z. Phys. Chem. NF 144, 129-159 (1965)] is criticized. A model which emphasizes the role of configurational entropy, due to interstitial sites of different energies, is proposed. The preferred absorption sites are identified by using a "Central Atoms" model. 7 figures.

33432 **Dependence of hydrogen chemisorption and desorption isotherms on d-bandfilling in rare earth-transition metal and thorium-transition metal intermetallic compound surfaces.** Siegel, E. (Molecular Energy Research Co., Westwood, NJ). pp 9p, Paper 2A15 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The effect of number d-hole/atom (= 10/sup -x/ d-bandfilling) of the transition metal on hydrogen desorption isotherms is treated via the Siegel—Kemeny [Phys. Status Solidi (b), 50, 519 (1972)] TDHM & TDHM applied to the transition metal component of rare earth—transition metal and thorium—transition metal intermetallic compounds. The trends are in agreement with those found by Buschow- van Malt & Miedema. 3 figures.

33433 Isotope dependent formation kinetics of H/sub β/ and D/sub β/ phases in ferromagnetic NiCu. Bauer, H.J.; Schenk, H.J. (Univ., Munich). pp 7p, Paper 1E2 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The cathodic charging with H/D of a NiCu alloy containing 30 at.% Cu (β-phase) followed by magnetic measurements indicates that D penetrates faster into the alloy than H. The dependence of absorption velocities on thickness of alloy foils and on temperature shows the same tendency. 3 figures, 1 table.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 32557, 32656, 32699, 32856, 32857, 32858, 32969, 33415, 33416, 33417

33434 (AD—045134) **Scanning electron microscope study of porous zinc battery electrode oxidation after service-like exposures in potassium hydroxide electrolyte.** Savory, J.R. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1977. 166p. NTIS PC A08/MF A01.

Porous zinc battery electrodes were modeled for study of the oxidation products that are produced during discharge in an alkaline battery. Two- and three-dimensional pore models were used in the study. The electrodes were discharged galvanostatically in electrolyte solutions of potassium hydroxide. Oxidation product morphology was studied with a scanning electron microscope. Two types of oxidation product were observed. One type appeared to form directly on the electrode surface as the result of reaction between the zinc and the electrolyte. This product was dark colored and fairly complete on passivated surfaces. The other type of product was light colored and incomplete. It appeared as a second layer, usually found on top of the darker product. This second type of product appears to precipitate out of solution at passivation. Strong pitting of the zinc base metal accompanies the production of oxidation product.

33435 (AD—045331) **The role of trapping on hydrogen transport and embrittlement. Technical report.** Pressouyre, G.M.; Bernstein, I.M. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Metallurgy and Materials Science). Jul 1977. Contract N00014-75-C-0265. 336p. NTIS PC A15/MF A01.

The achieved goal of the present research was to propose sets of criteria that would help in the design of alloys more resistant to hydrogen embrittlement. The research is based upon the original idea that a fine and homogeneous distribution of particular kinds of traps could achieve the above goal. This starting idea was developed from an investigation of existing hydrogen embrittlement theories, which showed that a common factor of all theories was the presence in the matrix of large deleterious accumulations of hydrogen at specific sites. Fe-Ti alloys in both the carburized and uncarburized condition were chosen as the model material to simulate internal trapping of hydrogen. Microstructure characterization revealed that all alloys consisted of a ferrite matrix in which free substitutional titanium atoms and titanium carbide particles were present. Techniques were developed to distinguish between reversible traps (titanium atoms, dislocations, grain boundaries, coherent particles) and irreversible traps (such as titanium carbide particles). This characterization separation was achieved both experimentally (using an electrochemical permeation cell) and theoretically (by proposing two new models of reversible and irreversible trapping, and by comparison with existing theories).

33436 (AED-Conf—77-120-000) **Corrosion by seawater. Abstracts.** (Fachhochschule Wilhelmshaven (Germany, F.R.)). 1977. 118p. (In German). (CONF-770456—(Absts.)). Dep. NTIS (US Sales Only), PC A06/MF A01.

From Meeting on corrosion by seawater; Wilhelmshaven, F.R. Germany (28 Apr 1977).

Abbreviated statements are presented of 12 papers on various aspects of corrosion by seawater. The topics discussed include the behavior of unalloyed steels and corrosion-resistant steels, Cu, Ni, and Ti alloys for marine applications, the behavior of aluminum construction materials, corrosion protection by non-metallic coatings, zinc coatings, and concrete liners, corrosion inhibitors and passivation, corrosion protection on ships, at an oil refinery, in pipelines and armatures, and in a tanker unloading bridge is illustrated with specific examples. (JSR)

33437 (CONF-780308—6) **Lithium compatibility research: status and requirements for ferrous materials.** Selle, J.E.; Olson, D.L. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 29p. Dep. NTIS, PC A03/MF A01.

From NACE meeting on corrosion; Houston, TX, USA (6 Mar 1978).

A brief historical review and a description of the present status of the knowledge accumulated on lithium-ferrous alloy corrosion research are presented and discussed. The effects of various parameters are discussed and the future requirements of lithium corrosion research are presented and discussed.

33438 (COO—2576-6) **Elastic and plastic strains and the stress corrosion cracking of austenitic stainless steels. Progress report, April 30, 1977—December 30, 1977.** Troiano, A.R. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Jan 1978. Contract EY-76-S-02-2576. 43p. Dep. NTIS, PC A03/MF A01.

A newly developed test environment based on NaCl, Na_2SO_4, and HCl has provided some insight to several aspects of SCC in a transformable austenitic stainless steel. Current vs. time curves indicated the presence of the formation of a "protective" film which drastically reduced the anodic current leading to failure. This film, not indicated by the polarization curves, is subject to highly localized damage such as pitting. Thus, although it allows only very small corrosion currents, it is not truly protective. Hence, it is pseudo-passive. The critical cracking potential did not exhibit any difference between the annealed and the maximum (25%) deformation examined. The corrosion or open circuit potential for both annealed and deformed material behaved in a similar manner, becoming more noble with time until it reached the critical cracking potential and SCC ensured. The failure time for the deformed specimens was substantially shorter than for the annealed ones, but the incubation time was essentially the same. Within the range of experimental conditions examined thus far, it appears that the critical parameters leading to SCC in a chloride environment are primarily dependent on surface-environment interactions and not dependent on the bulk properties.

33439 (COO/2872—2) **Hydrogen attack of steel. Progress report, April 1, 1977—March 31, 1978.** Shewmon, P.G. (Ohio State Univ., Columbus (USA). Dept. of Metallurgical Engineering). Dec 1977. Contract EY-76-S-02-2872. 11p. Dep. NTIS, PC A02/MF A01.

Four carbon steels of approximately equivalent carbon content and varying mainly in the method of steelmaking, i.e., semi-killed, fully-killed, REM-treated, and electroslag refined (ESR), are being studied to determine the effect of deoxidation practice and inclusion morphology on the hydrogen attack of carbon steel. To date tests have been run on a cold-rolled steel (to develop experimental techniques), the semi-killed, and REM-treated materials. Heat treatment for the latter two steels consisted of 60 minutes at 890°C and air cooling to give an average grain size of ASTM No. 8. Significant results are: (1) hydrogen attack results in substantial (factor of ten) greater growth normal to the rolling plane than in the rolling plane; (2) metallography and fractography show a few areas with many microscopic bubbles in the REM-treated steel indicating high bubble nucleation rates on some boundaries and much lower on most boundaries; (3) incubation times, t/sub i/, are on the order of 4 to 5 times that predicted from Weiner's equation. The anisotropy relatives to the rolling plane occurred in all three steels treated. Thus it would seem reasonable that such variables as inclusions or segregation tend to determine the local extent of hydrogen attack. This anisotropy will be examined further in the next series of experiments by comparing all four steels. Of special interest will bethe results of the ESR steel, in which the inclusion content and solidification segregation is significantly reduced.

33440 (EPRI-FP—686) **Spalling of steam-grown oxide from superheater and reheater tube steels. Technical planning study 76-655. Final report.** Armitt, J.; Holmes, R.; Manning, M.I.; Meadowcroft, D.B.; Metcalfe, E. (Central Electricity Research Labs., Leatherhead (UK)). Feb 1978. 165p. Dep. NTIS, PC A08/MF A01.

This technical planning study examines world experience outside the U.S. on the spalling of steam-side oxide scale from austenitic and ferritic superheater and reheater tube materials with special emphasis on the study of this problem being conducted in the U.K. The physical properties of the oxide scales are reviewed and expansion coefficient data are used to estimate the cooling strains in the oxide for various alloys. Other contributory sources of strain are discussed and models are presented for the failure behavior of oxide layers both in tension and in compression. A method of predicting quantities of debris release is described. The hydrodynamic behavior of spalled oxide flakes in steam circuits is considered analytically and the conclusions are used to construct a method for assessing the risk of tube blockages. Attention is drawn to the importance of the kinetic energy of the debris particles in affecting wear rates on the eroded circuit components. The concluding sections of the study examine the various palliative operational and design solutions to

prevent turbine erosion and tube blocking, and highlight the areas where further study of the problem are required.

33441 (K—2004) Polarization behavior of selected cathodic reactions used in corrosion testing of stainless steels and nickel base alloys. Huffstetler, V.C. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Feb 1978. Contract W-7405-ENG-26. 119p. Dep. NTIS, PC A06/MF A01.

The electrochemical nature of three different acid solutions was examined and factors affecting the shape of the polarization curves were evaluated. Potentiodynamic polarization curves were obtained for 10% hydrochloric acid, 50% sulfuric acid-0.1 M ferric sulfate, and 10% chromic acid on a platinized platinum surface and on various nickel rich alloys. The polarization measurements were generally conducted at room temperature in hydrogen saturated solutions. However, several polarization curves were also measured in aerated solutions in order to determine the influence of oxygen on the electrochemical characteristics of each acid. Conclusions from this investigation are given.

33442 (K/CSD—9) Exact solution of diffusion and absorption of hydrogen in uranium followed by fracture of the hydride. Kirkpatrick, J.R. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). Nov 1977. Contract W-7405-ENG-26. 28p. Dep. NTIS, PC A03/MF A01.

The diffusion of hydrogen in uranium and its absorption to form the hydride can be crudely modeled below approximately 250°C by a simple expression which may be numerically integrated. When a certain fraction of the uranium has turned to hydride, the material will tend to fracture. The fracture or "spall" front may be modeled as a moving boundary. When this is done in conjunction with the diffusion-absorption model, it is found that the hydrogen and hydride concentrations are simple functions of the normalized distance from the spall front. These distributions may be used to develop an expression for the motion of the spall front and integrated to give an expression for total weight gain. The analytic solution for weight gain rate matches available data below 250°C within a factor of 2.

33443 (KAPL-P—4057) Corrosion failure analysis as related to prevention of corrosion failures. Suss, H. (Knolls Atomic Power Lab., Schenectady, N.Y. (USA)). Oct 1977. Contract EY-76-C-12-0012. 29p. (CONF-771161—1). Dep. NTIS, PC A03/MF A01.

From ASM meeting; Hartford, CT, USA (8 Nov 1977).

The factors and conditions which have contributed to many of the corrosion related service failures are discussed based on a review of actual case histories. The anti-corrosion devices which developed as a result of these failure analyses are reviewed, and the method which must be adopted and used to take advantage of the available corrosion prevention techniques is discussed. (GHT)

33444 Studies on the corrosion behaviour of copper in heating systems. Eisen, J.; Winkler, B. (Kabel- und Metallwerke Gutehoffnungshuette A.G., Osnabrueck (Germany, F.R.)). *Metall;* **31**: No. 11, 1235-1237(Nov 1977). (In German).

Some cases of corrosion in parts of central heating equipment made of copper are described, which do not behave as usual. The reason for this behavior is the formation of a sulfide bearing coating. The cause of this sulfide bearing coating is supported by results of the investigation critically discussed. It can be shown that such a coating can only form in heating equipment not operated according to the technical rules (e.g. VDI Richtlinie 2035).

33445 Nature, importance, features of external hydrogen embrittlement (EHE). Fidelle, J.P.; Criqui, B.; Arnould-Laurent, R.; Broudeur, R. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel, France). pp 8p, Paper 3D1 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

EHE is due to hydrogen absorption; this can be greatly enhanced by dislocations. It exists between -196 and +1000°C, is very sensitive to the environment purity, and affects a great deal of materials including γ steels. It is compared to internal hydrogen embrittlement and stress corrosion cracking. 3 figures, 47 references.

33446 Influence of molecular hydrogen and hydrogen sulphide on crack formation during and after plastic deformation of steels and brasses. Erdmann-Jesnitzer, F.; Uhlig, P.W. (Inst. for Material Science Tuh, Hanover). pp 8p, Paper 3D2 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

The embrittlement of austenitic stainless steels and α-brasses was investigated in an environment of molecular hydrogen or hydrogen sulfide under variation of the specific strain rate, the hydrogen pressure, the specimen shape, and the heat treatment. 9 figures, 2 tables.

33447 Gaseous hydrogen embrittlement of Ti—8Al—1Mo—1V. Koch, G.H.; Bursle, A.J.; Pugh, E.N. (Univ. of Illinois, Urbana). pp 6p, Paper 3D4 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

Metallographic, fractographic, and acoustic-emission studies were carried out on Ti—8Al—1Mo—1V tested at room temperature in 1 atmosphere gaseous hydrogen. The studies provided evidence for the presence of fcc titanium hydride at the fracture surfaces and for the discontinuous nature of crack propagation. 5 figures.

33448 Crack growth rate of an uranium-10wt% molybdenum alloy in hydrogen under low pressure. Corcos, J.; Nomine, A.M.; Miannay, D. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel, France). pp 8p, Paper 3D5 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

Crack growth data for U—10 Mo alloy in H_2 under 0.15 MPa pressure are given between -50°C and +135°C. The phenomenon is thermally activated with an energy being that of formation of a described brittle and metastable hydride. This hydride causes cracking. 5 figures.

33449 Development of a testing technique in an attempt to measure the inhibiting effect of trace oxygen on hydrogen embrittlement. Zmudzinski, C.; Bretin, L.; Toitot, M. (Creusot-Loire, France). pp 8p, Paper 3D6 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

Keeping up with advances in the field of "process" industries required that a set-up for rupturing discs in a hydrogen atmosphere of extreme purity be developed. It is thus possible to determine a maximum sensitivity to hydrogen and the influence of such contaminants as oxygen. 5 figures.

33450 Effect of hold time on the embrittlement under pressurized hydrogen. Ruge, J.; Schroeder, G. (Inst. Fuer Schweisstechnik, Brunswick). pp 8p, Paper 3D9 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

The influence of holding time and initial loading on the pressure hydrogen embrittlement of a low-alloy steel was studied. In spite of a hydrogen pickup during the holding time, no additional influence on the embrittlement of the material was detected. 4 figures, 4 tables.

33451 Embrittlement of nickel by gaseous hydrogen. Kamdar, M.H. pp 11p, Paper 3D10 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

High-purity nickel single crystals and polycrystals were tested in tension in a low-pressure gaseous hydrogen environment at -130°C to 20°C fracture by transgranular mode. These results suggest that embrittlement is caused by reduced cohesion of nickel—nickel bonds by hydrogen atoms, contrary to the recent suggestion that increased concentrations of certain impurities in the grain boundary, as opposed to those within the grain, act as recombination poison for hydrogen atoms and thus cause intergranular failure of nickel. 11 figures, 2 tables.

33452 Alloy ultra-high-strength steel under cyclic and sustained stresses in gaseous hydrogen. Lynch, S.P.; Ryan, N.E. (Aeronautical Research Labs., Melbourne). pp 8p, Paper 3D12 of Hydrogen in metals. Volume 5. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P5.

Rates of fatigue-crack growth for D6aC steel in hydrogen are inversely proportional to rates of loading; no correlations were observed between rates of sustained and cyclic-load cracking. It is proposed that chemisorption of hydrogen facilitates nucleation of dislocations at crack tips. 4 figures.

33453 Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977). 125p. (In French and English). (CONF-770613—P2).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

A separate abstract was prepared for each of the 16 papers in this volume. (RWR)

33454 Hydrogenation and dehydrogenation of steel. Abol-Hassan, K.; Abdel-Aziz. (Univ., Alexandria, Egypt). pp 5p, Paper 1A6 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

The electrolytic hydrogenation of plain carbon steel causes an increase in the hardness and the corrosion resistance and a decrease in the Izod number. The period for hot vacuum extraction of hydrogen from a cylindrical sample is independent of its mass. 6 figures.

33455 Diffusion of hydrogen in heat treated martensitic type 403 stainless steel. Sakamoto, Y.; Hanada, U. (Nagasaki Univ., Japan). pp 7p, Paper 1A7 of Hydrogen in metals. Volume 2. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P2.

An investigation of hydrogen diffusion through martensitic Type 403 stainless steel subjected to heat treatment over a wide range of temperatures was carried out at room temperature in an attempt to establish the effect of heat-treated microstructure on the diffusion coefficient and solubility of hydrogen. 7 figures.

33456 Hydrogen diffusion simulations around plastically deformed notch region. Kikuta, Y.; Ochiai, S.; Kangawa, T. (Osaka Univ.). pp 8p, Paper 3F1 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

Hydrogen delayed cracking initiation is induced by combination of applied tensile stress and local hydrogen gathering. Simulations were done for both time-wise gathering of hydrogen at fixed locations and the distribution contours at fixed times, and were correlated with the behaviors of triaxial stress states at notch root. 13 figures, 1 table.

33457 Quantitative analysis of hydrogen-induced cracking. Van Leeuwen, H.P. (NLR, Amsterdam). pp 10p, Paper 3F2 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

An analysis is made of embrittlement due to internal and external hydrogen, and of stress corrosion cracking of a low-alloy high-tensile steel. Mathematical expressions are derived which can predict the characteristics of these three forms of embrittlement. 6 figures, 1 table.

33458 Hydrogen-induced slow crack growth in austenitic stainless steel. Eliezer, D.; Chakrapani, D.G.; Altstetter, C.J.; Pugh, E.N. (Univ. of Illinois, Urbana). pp 7p, Paper 3F5 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

Type 304 and type 310 steels were tested while either exposed to gaseous hydrogen or undergoing cathodic charging. Slow crack growth was observed in type 304, and the formation of α' martensite was found to be necessary for such cracking. 2 figures, 1 table..

33459 Hydrogen and the stress-corrosion cracking of austenitic stainless steels. Keys, L.H.; Bursle, A.J.; Kemp, H.R.; Thompson, K.R.L. (Univ. of New South Wales, Sydney). pp 8P, Paper 3F6 of Hydrogen in metals. Volume 3. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P3.

The fracture surfaces of some stable austenitic chromium—nickel—iron alloys cracked in $MgCl_2$ were found to contain ferromagnetic particles, identified as alpha martensite in some cases. The presence of cracks was observed for some alloys before the maximum in potential curves was reached. 7 figures, 1 table.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 34299

33460 (BNWL-SA—2298A) Fractography of irradiated and unirradiated pressure vessel steel impact specimens. Hellerich, C.L.; Hunter, C.W. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1 Feb 1969. Contract EY-76-C-06-1830. 25p. (CONF-690306—2). Dep. NTIS, PC A02/MF A01.

From WESTEC conference of the american society for metals; Los Angeles, CA, USA (10 Mar 1969).

Recent developments have made a new tool available for electron fractography studies—the scanning electron microscope. Utilizing this tool, a fractographic analysis was made of Charpy specimens of A302-B pressure vessel steel fractured over the impact-transition curve. Temperature, second phase inclusions and restraint due to both specimen geometry and local fracture surface geometry greatly influenced the local fracture mechanism and overall fracture appearance. Special emphasis was placed on determining the interrelationship between these parameters. Inclusions were identified by microprobe analysis and related to the local fracture mechanism. The roles of second phase inclusions of varying size and population density in the fracture process were analyzed and subsequently characterized as (a) dimple formers, (b) cavity formers, and (c) flaw formers. Based on these studies, neutron irradiated specimens of A302-B pressure vessel steels and A543 weldment were impact fractured and fractographically analyzed to determine the cause of irradiation embrittlement. It was determined that the embrittlement of the irradiated steels studied was similar to that caused by a decrease in test temperature.

33461 (IAEA—199, pp 175-184) Blistering of stainless steels by He^+ ion bombardment. Navinsek, B.; Zabkar, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting.

The surface erosion and blistering produced by high dose 6 and 10keV He^+ ion bombardment in PROKRON 11 spec. and PROKRON 12 stainless steels have been studied using optical microscopy, scanning electron microscopy and the high resolution replica technique. The total ion dose was varied from 5.10^{17} to 10^{19} ions/cm^2 and the irradiation temperature was varied from room temperature to 650°C. The results show that the influence of surface pre-treatments on the topography to be developed under low-energy He^+ bombardment is much greater for stainless steels than for other pure metals used for the first wall in fusion reactor. Only a few widely dispersed blisters of diameter 0.2-0.5μm were found on stainless steel samples bombarded at room temperature, some of which were attached at inclusions and various precipitates, while larger areas of the bombarded spot remained unaffected. The ion micro-erosion effect - on the few 100A scale - was observed all over the irradiated samples. The roughness of this "background" increased with target temperature. At 650°C blisters and "background" structure have similar diameters, while the height variations are larger than the diameter of surface features. Surface structure depends strongly on grain orientation and on the thermal treatment before irradiation.

33462 (WAPD-TM—1306) Post-irradiation recovery of growth in Zircaloy (AWBA Development Program). Dollins, C.C. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Dec 1977. Contract EY-76-C-11-0014. 14p. Dep. NTIS, PC A02/MF A01.

The previously reported model for fast neutron induced growth in Zircaloy has been modified to predict post-irradiation recovery of the growth. The predicted results are compared to growth recovery data obtained by Adamson. Agreement is good if the binding energy between vacancies and depleted zones is reduced from the in-pile value of 1.1 eV to a post-irradiation value of 1.0 eV. Such a reduction is reasonable.

33463 Hydrogen ion bombardment effects in metals. Daniels, R.D. (Univ. of Oklahoma, Norman). pp 8p, Paper 2A12 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Protons implanted in metals can cause surface blistering. The size, density, and shape of blisters and the critical dose for their formation are functions both of material parameters and radiation parameters. The relationships are demonstrated in aluminum. 2 figures.

33464 Hydrogen implantation in metals. Bugeat, J.P.; Ligeon, E. (Centre d'Etudes Nucleaires, Grenoble, France). pp 6p, Paper 2A13 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Ion beam techniques were used for the characterization of light-element implantation in metals. Experimental results in Al and Au show that the implanted hydrogen occupies an interstitial site in the lattice and is bound to the vacancies created during the implantation. 5 figures.

33465 Effect of hydrogen (deuterium) on properties of fusion power reactor first wall alloys. Panayotou, N.F.; Tien, J.K.; Gross, R.A. (Columbia Univ., New York). pp 12p, Paper 2A14 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Candidate first wall fusion reactor materials were subjected to a deuterium bombardment comparable to that of anticipated reactors. Significant microstructural and mechanical damage modes were observed. The mechanisms involved and the relevance of deuterium interactions to fusion is discussed. 4 figures, 1 table.

CERAMICS, CERMETS, AND REFRACTORIES

REFER ALSO TO CITATION(S) 33343

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 32808, 33185, 33188, 33481

33466 (AD—045328) **On the techniques for preparing refractory metal hydrogen alloys for T.E.M. studies. Technical report.** Makenas, B.; Birnbaum, H.K. (Illinois Univ., Urbana (USA). Dept. of Metallurgy and Mining Engineering). May 1977. Contract N00014-75-C-1012. 3p. NTIS PC A02/MF A01.

The preparation of refractory metal - hydrogen alloys for T.E.M. studies has presented many experimental difficulties. It is the purpose of this note to report some of the problems encountered and to describe a successful procedure for specimen preparation. (Author)

33467 (CONF-771037—, pp 241-243) **Stirling engine project status.** Ragsdale, R.G. Mar 1978.

From ERDA contractors' coordination meeting; Detroit, MI, USA (4 Oct 1977).

In Highway vehicle systems.

The three objectives of the Stirling engine program described are summarized as follows: (1) improved engine production engineering decision by industry in 1984-85; (2) advanced engine definition by 1983; and (3) develop enabling technology for advanced engine production in 1990's. Project organization, approach, and plans are briefly discussed, and the present status of the project is summarized.

33468 (SAND—77-2070) **RF plasma enhanced vapor deposition and etching of silicon nitride.** Hampy, R.E. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1978. Contract EY-76-C-04-0789. 56p. Dep. NTIS, PC A04/MF A01.

This is a report on the deposition and etching of silicon nitride films using RF plasma techniques. Experiments were conducted to determine optimum operating parameters (e.g., gas flow rates, temperature, power, and pressure) for the AMT (Applied Materials Technology) Plasma I reactor in both the deposition and etching modes of operation. Silane and ammonia with nitrogen as a carrier gas are used during deposition. Film properties were measured as selected operating parameters were changed in deposition experiments. Good quality Si_3N_4 films for semiconductor device passivation purposes were made in thicknesses of 300 to 10,000 A with refractive indices between 2.0 and 2.1 and at deposition rates of 250-300 A/min. The relatively low (approximately 300°C) deposition temperature makes the process compatible with devices metallized with aluminum. Plasma etching of Si_3N_4 films using tetrafluoromethane with 8% oxygen added was successful using standard photoresists and at etch rates of 400-1000 A/min.

33469 (SLAC-PUB—1933) **Reactive sputter-thinning of large diamonds while preserving excellent crystalline perfection.** Garwin, E.L. (Stanford Linear Accelerator Center, Calif. (USA)). May 1977. Contract EY-76-S-03-0376. 4p. (CONF-770908—9). Dep. NTIS, PC A02/MF A01.

From 7. international Vac. congress and 3. international conference on solid surfaces; Vienna, Austria (12 Sep 1977).

Production of monochromatic bremsstrahlung beams for high-energy physics at SLAC required thin slabs of (100) face diamond crystals with high crystalline quality. The starting material was selected to have double-crystal spectrometer /1/ rocking curves less than 20 seconds of arc in width. A radio-frequency sputtering process using argon-2% oxygen is described which has produced 7 mm-square diamond slabs 48 μm thick, with a uniformity of a few percent, from starting material 10 times the finished thickness. Etching rates of 45 μm/day are routinely obtained. Details of sputtering system design and process parameters are given, as well as their effect on etch rate and thickness uniformity. Double-crystal spectrometer rocking curves are shown to indicate the effect of sputtering and the final inert gas annealing step in maintaining the 20 arc-second rocking curve. Effects of annealing on electron-beam-induced radiation damage will also be demonstrated.

33470 Transition metal carbide and boride abrasive particles. Valdsaar, H. (to E. I. Du Pont de Nemours and Co.). US Patent 4,076,506. 28 Feb 1978. Filed date 30 Sep 1976. 20p.

Abrasive particles and their preparation are discussed. The particles consist essentially of a matrix of titanium carbide and zirconium carbide, at least partially in solid solution form, and grains of crystalline titanium diboride dispersed throughout the carbide matrix. These abrasive particles are particularly useful as components of grinding wheels for abrading steel. 1 figure, 6 tables.

33471 Ideal resistivity and electron—phonon interaction in Pd—H/sub x/. Gorska, A.; Gorski, A.M.; Igalson, J.; Pindor, A.J.; Siniadower, L. (Inst. of Physics, Warsaw). pp 6p, Paper 2A10 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The temperature dependence of Pd-H/sub x/ resistivity for hydrogen concentrations from 0.872 to 0.909 was measured, and a model for electron—phonon interaction was used to estimate the relative magnitudes of lambda/sub ac/ and lambda/sub op/ and trends in their behavior with concentration. 1 figure, 1 table.

33472 Hydride formation in Ni—Fe alloys in high pressure gaseous hydrogen followed by magnetization measurements. Bauer, H.J.; Baranowski, B. (Univ., Munich). pp 5p, Paper 1E1 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

With a newly developed magnetic microdevice the formation and decomposition of NiFe hydride (below 16 at.% Fe) in high pressure gaseous hydrogen (up to 20 kbar) could be followed by using the magnetic changes which accompany them. 2 figures.

33473 (UCRL-Trans—11304) **Possibiliy of making high quality fluoroberyllate optical glasses in crucibles with pyrocarbon linings.** Evstrop'ev, K.S.; Krylov, V.N.; Petrovskii, G.T.; Doladugina, V.S.; Borisov, B.A.; Khalilev, V.D.; Shashkin, V.S. Translated from *Tr. Gos. Opt. Inst.;* **39**: No. 170, 75-81(1972). 11p. Dep. NTIS, PC A02/MF A01.

A proposed method for producing fluoroberyllate glass with transparency in the 150 to 5000 nm range, sharp optical constants and chemical inertness to the effects of fluorine and hydrogen fluoride is presented. (GHT)

33474 (UCRL-Trans—11289) **Transparency and homogeneity of glasses based on beryllium fluoride.** Khalilev, V.D.; Doladugina, V.S.; Evstrop'ev, K.S. Translated from *Tr. Gos. Opt. Inst.;* **30**: No. 170, 70-74(1972). 9p. Dep. NTIS, PC A02/MF A01.

Fluoroberyllate glass properties were studied for different melt conditions. When fluoroberyllate melts interact with oxygen and moisture in air, the transparency of the glasses obtained is reduced and their homogeneity is disrupted. Because of this, to obtain low-striation optical fluoroberyllate glasses transparent in the wavelength range 160-5000 nm, they must be melted down and handled in a dry inert atmosphere. The use of hydrogen fluoride in melting down fluoroberyllate glasses greatly complicates the founding process and offers no advantages over nitrogen. (GHT)

STRUCTURE AND PHASE STUDIES

REFER ALSO TO CITATION(S) 32856

33475 Electron structure and character of the interaction in hydrides of light rare earth metals. Lileeva, Yu.Ya.; Maluchkov, O.T.; Zvonkov, S.D. (Inst. for Steel and Alloys, Moscow). pp 4p, Paper 2A2 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The suggested model of electron structure of hydrides for light rare earth metals of the compositions MeH_3—MeH_3 allows treatment of the peculiarities of their physical properties as the order number of metallic atoms across the period of the periodic table increases. 1 figure, 2 tables.

33476 Studies of the decomposition process of nickel hydride by Bitter powder pattern and Laue method. Jonitz, D.; Bauer, H.J. (Univ., Munich). pp 6p, Paper 1E3 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Structural changes during the decomposition process of the system Ni—H/sub β/ (atomic ratio H/Ni from 0.6 to 1), accompanied by a magnetic phase transition, were examined by revealing the magnetic structure on the surface of crystallites. Laue reflection photographs give information about the interior of them. 3 figures.

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 33431, 33474, 33475

33477 (ARH-SA—293) **High-temperature borate liquids: physical properties of glass-forming compositions.** Riebling, E.F. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 6 May 1977. Contract EY-76-C-06-2130. 14p. (CONF-770698—2). Dep. NTIS, PC A02/MF A01.

From Conference on boron in glass and glass ceramics; Alfred, NY, USA (5 Jun 1977).

Several experimental routes can be used to develop a better understanding of the polymeric constitution (polyanionic and/or polyhedral distribution) of borate, germanate, and silicate glasses. Spectral, chemical, physical-chemical, and mechanical property information can be determined directly for the glass compositions of interest. Generally, only physical-chemical information is readily accessible for the corresponding high temperature liquids. It will be shown that information on each state of matter has its own particular merits. Most of the evidence thus far published suggests an excellent agreement between polyhedral distributions in an oxide glass and its corresponding high temperature liquid state. There is no well known oxide glass forming system for which such a state of affairs does not exist. In spite of this, occasional efforts are put forth which ignore some of what is known for oxide liquids, glasses, and crystals. Such attempts therefore invariably imply, if only indirectly, that significant changes occur in the polyhedral distributions close to the glass transition temperature region. Specific examples to be discussed will include efforts that avoid well known coordination change equilibria such as BO_3 reversible BO_4 and GeO_4 reversible GeO_6.

33478 **Hydrogen in metals. Volume 8.** Elmsford, NY; Pergamon Press Inc. (1977). 139p. (In English and French). (CONF-770613—P8).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

A separate abstract was prepared for each of the 20 papers in this volume. (RWR)

33479 **Calculation of band structure and some electronic properties of titanium and nickel hydrides.** Kulikov, N.; Zvonkov, A.; Malyuchkov, O. (Inst. of High Pressure Physics, Moscow). pp 8p, Paper 2A1 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The approximation method for solving the Korringa—Kohn—Rostoker equation was used to calculate the band structures of titanium and nickel dihydrides and nickel hydride. The results are compared with experimental data. 3 figures, 3 tables.

33480 **Some thermodynamic aspects of the palladium—hydrogen system.** McLellan, R.B. (Rice Univ., Houston, TX). pp 8p, Paper 2A7 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977).

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The thermodynamic and kinetic properties of palladium—hydrogen solid solutions are discussed in terms of the dual site occupancy of H atoms in both tetrahedral and octahedral interstitial sites. 2 figures.

33481 **Electronic properties of palladium based hydrides prepared at low temperature.** Souffache, B.; Burger, J.P. (Paris Univ., Orsay, France). pp 5p, Paper 2A8 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

The preparation of Pd-based hydrides using a low-temperature electrolysis at -75°C is described. Results concerning resistivity and magnetic properties of several alloys are discussed. 3 figures.

33482 **Transport properties of palladium hydrides with transition impurities.** Senoussi, S.; Burger, J.P. (Paris Univ., Orsay, France). pp 7p, Paper 2A9 of Hydrogen in metals. Vol. 8. Elmsford, NY; Pergamon Press Inc. (1977). (In French)

From 2. international congress on hydrogen in metals; Paris, France (Jun 1977).

See CONF-770613—P8.

Measurements of the Kondo resistivity of some 3d transition impurities in Pd-H/sub x/ are presented. The variation of this resistivity with the H concentration x is discussed. The phonon resistivity at low temperature was also measured.

CORROSION AND EROSION

REFER ALSO TO CITATION(S) 32971

COMPOSITE MATERIALS

PREPARATION AND FABRICATION

33483 (BDX—613-1915) **Improved bondability of molded rigid urethane form by plasma treatment.** DeGisi, S.L.; Smith, C.H. (Bendix Corp., Kansas City, Mo. (USA)). [nd]. Contract EY-76-C-04-0613. 11p. Dep. NTIS, PC A02/MF A01.

Most mold releases, including so-called nontransferring releases, interfere with bonding of molded urethane foam. Water-washable mold releases are not readily removable from urethane foams cured at elevated temperatures. Plasma treatment in either argon or oxygen improves the bonding surfaces of molded urethane foam. Comparable bonding results can be obtained with RF (13.6 MHz), AC (20 kHz), or DC-plasma treatments. The plasma-treated foam surfaces will retain the improved bondability for a considerable length of time. Plasma treatment is effective for epoxy and RTV silicone adhesives. A primer recommended for metal bonding with RTV silicone, together with plasma treatment, produces superior bondability of molded urethane foam parts.

POLYMERS AND PLASTICS

PREPARATION AND FABRICATION

REFER ALSO TO CITATION(S) 32887

PHYSICAL PROPERTIES

REFER ALSO TO CITATION(S) 32887

33484 (BDX—613-1790(Rev.)) **Syntactic foam from silver coated microbubbles.** McIlroy, H.M. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1978. Contract EY-76-C-04-0613. 22p. Dep. NTIS, PC A02/MF A01.

A low density syntactic foam made from a blend of a polyimide resin and silver coated glass microbubbles has been evaluated. Foams prepared from the silver coated glass microbubbles have more than twice the thermal conductivity of foams made from uncoated glass microbubbles, but the value is about 10 percent less than the measured thermal conductivity of carbom microbubble foams.

RADIATION EFFECTS

REFER ALSO TO CITATION(S) 33514

OTHER MATERIALS

PREPARATION AND MANUFACTURE

REFER ALSO TO CITATION(S) 32808, 32885, 33185, 33411

PROPERTIES

REFER ALSO TO CITATION(S) 32914

CORROSION, EROSION, AND DEGRADATION

REFER ALSO TO CITATION(S) 33429

33485 (GA-A—14657) **Effect of steam oxidation on the strength and elastic modulus of graphite H-451.** Velasquez, C.; Johnson, W.; Hightower, G.; Burnette, R. (General Atomic Co., San Diego, Calif. (USA)). Dec 1977. Contract EY-76-C-03-0167-017. 56p. Dep. NTIS, PC A04/MF A01.

Graphite grade H-451, the reference material used as fuel and reflector elements in General Atomic large high-temperature gas-cooled reactors, was oxidized to 20% burnoff by weight in steam-helium mixtures, and the effects of oxidation on ultimate tensile strength (UTS) and elastic modulus (E) were studied. Large numbers of small cylindrical samples cored from selected locations in a log of preproduction H-451 graphite were oxidized at 1073 and 1273 K (1472° and 1832°F) in helium containing 3% water vapor and 5%

H_2. The UTS and E of oxidized specimens were measured and the results compared with those for nonoxidized control specimens. The average rate of change of UTS and E with burnoff at 1273 K (1832°F) (up to 20% burnoff) averaged 3.6% and 5.2%, respectively. Statistical analysis (comparison of population means) of the low burnoff strength data showed no significant differences between the nonoxidized control and oxidized specimens at burnoffs of up to approximately 2%.

RADIATION EFFECTS

33486 (AD-A—045934) **Effect of neutron radiation on the elastic moduli of gallium arsenide.** Sirota, N.N.; Kurilovich, N.F. Translated by *Dokl. Akad. Nauk SSSR;* **20**: No. 11, 978-981(1976). 13p. (FTD-ID(RS)T—0838-77). NTIS PC A02/MF A01.

Up to now virtually no studies have been made on the effect of radiation on the elastic properties of gallium arsenide. Moreover, interest in electronic equipment and quantum electronics has made it necessary to conduct systematic studies in this area. The elastic moduli, which are important characteristics of crystals, determine many of their properties; they are uniquely related to the crystal structure and the nature and energies of interatomic interactions.

CHEMISTRY

ANALYTICAL AND SEPARATIONS CHEMISTRY

REFER ALSO TO CITATION(S) 32607, 33754

33487 (UCD—472-124, pp 34-40) **Fly ash filterability, differential solubility and elemental distribution studies.** Fisher, G.L.; Silberman, D.; Prentice, B.A.; Heft, R.E.; Ondov, J.M.; Ragaini, R.C. Oct 1977.

In Annual report, fiscal year 1977.

In a study of filterability, neutron-activated fly ash samples were dispersed in a physiological buffer and filtered through nuclepore membranes with pore sizes of 5, 2, 0.8, 0.4, 0.2, 0.1, 0.05, and 0.03 μm. The elements, Na, Ca, Co, Se, Mo and Ba, were partially soluble in the buffer, and their concentrations in the filtrates apparently did not depend on membrane pore size. Use of membranes with pore sizes less than or equal to 0.2 μm resulted in nearly quantitative recovery of all elements associated with insoluble particles. In a study of solubility, fly ash was extracted with H_2O, HCl and HF for evaluation of trace element distribution by analysis of differential solubility of fly ash components. The elements, Cr, Cu, Ca, Be and Ni, appear to be surface-related, whereas Si, Al, Na and K are matrix elements. Solubility of other elements is discussed in terms of solvent pH and possible solubility interferences.

33488 (UCD—472-124, pp 172-177) **Evaluation of Autoanalyzer II methodology for routine clinical chemistry measurements.** Munn, S.; Gielow, F. Oct 1977.

In Annual report, fiscal year 1977.

Six tests of the AutoAnalyzer II were compared with the procedures that were in current use by the laboratory. Five of the tests had been performed on the AutoAnalyzer I and the sixth test had been a manual method. The evaluation of the AutoAnalyzer II included within-run precision, batch-to-batch precision, carryover (interaction) and drift, as well as correlation studies. A cursory look at the effects of dilution also was undertaken. Five of the tests studied were found to be acceptable and have replaced the AutoAnalyzer I methods. The sixth test proved unacceptable. Correlation information was documented for future data analysis.

ACTIVATION AND NUCLEAR REACTION PROCEDURES

33489 (IEA—425) **Measurement of oxygen content of uranium oxide fuel and steel.** Calado, C.E.; Machado, E.L.; Holland, L. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Engenharia Nuclear). Aug 1976. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Quantitative oxygen analyses of uranium oxide and steel samples have been made using a pulsed fast neutron activation analysis system. The uncertainty in the measured oxygen content of uranium oxide is +-2.4%; that of steel varies from +-13% at 30 ppm of oxygen to +-4% at 300 ppm of oxygen. Samples were irradiated in a fast neutron flux of about 2×10^9 n.cm^{-2} s^{-1} produced by 400MeV deuterons on a tritium target. Samples N-16γ-ray activities (produced via the ^{16}O (n,p)^{16}N reaction) were measured using a 35 cc Ge(Li) detector (for uranium) and a 3″ x 3″ NaI detector (for steel). Individual activities were normalized against the measured β-ray activity of ^{16}N produced in a coveniently located water sample. Relative oxygen concentrations were absolutely normalized against the ^{16}Nγ-ray activity of standard samples. Extensive measurements and calculations were made to evaluate the relative importance of errors due to geometrical effects, electronic drift, γ-ray pile up and counting statistics. Ways in which the overall error can be significantly reduced are discussed.

CHEMICAL PROCEDURES

33490 (ANL-Trans—1123) **Potentiometric titration with EDTA using metallic bismuth indicator electrode.** Nomura, T.; Nakagawa, G. Translated from *Jpn. Anal.;* **19**: No. 3, 397-402(1970). 13p. Dep. NTIS, PC A02/MF A01.

From 10. annual meeting of the Chemical Society of Japan, April 1966.

Complexometric titration of various metal cations by a potentiometric end point detection with metallic bismuth indicator electrode was studied. Bismuth electrode was prepared by electrodeposition of bismuth on a spiral wire platinum electrode from an acidic tartrate solution. The potential of the bismuth indicator electrode is expressed by the equation, $E = E^0 + 0.0197 \log[Bi^{3+}]$. Bismuth ion is easily hydrolyzed and the upper limit of the electrode potential is limited with the solubility product of BiOOH and/or Bi_2O_3 above pH 3. Because of the formation of a stable complex by bismuth and EDTA and a very small interference from cloride ion with the electrode potential, the titration is done in a fairly acidic medium as compared with various other electrodes. The titration of Bi, In, Th, and Zr with EDTA can be carried out at pH between 0.5 to 2 in a potassium nitrate-nitric acid medium. Cu, Cd, Pb, Zn, and Co can be determined in a sodium acetate medium at pH 6, and Cu, Cd, Zn, Co, Ca, and Sr can be determined in an ammoniacal medium at pH about 10.

SPECTRAL PROCEDURES

REFER ALSO TO CITATION(S) 32599

33491 (IS-T—786) **Use of a semiconductor laser in infrared spectroscopy.** Morris, R.N. (Ames Lab., Iowa (USA)). Dec 1977. Contract W-7405-ENG-82. 157p. Dep. NTIS, PC A08/MF A01.

Thesis.

A semiconductor laser has certain properties which makes its use desirable as a continuous monitor of atmospheric pollutants. Its energy output is concentrated in widely separated energy modes of very narrow bandwidths (less than 10^{-5} cm^{-1}) which can be centered on one infrared absorption line of one gas. This makes the laser quite selective. The energy in each mode is typically greater than 200 μ watts, and, because of the laser's small size, its light energy can be collimated over large distances with minimal optical losses and be easily detected. One can rapidly measure the decrease in transmission of the light due to the absorption of the light by the gas being monitored, and, using certain analytical parameters, which are different for each absorption line, one can determine the concentration of the gas in question immediately. In addition to the line center (nu_0), these analytical parameters are the intensity (S) and the half width at half maximum (γ). The intensity (S) is dependent only on temperature when expressed in a per concentration basis and γ is dependent on pressure. The Lorentzian lineshape equation $K(nu) + S/\pi\gamma[[(nu - nu_0)/\gamma]^2 + 1]^{-1}$ is the equation which describes the absorption profile of a gas at ambient atmospheric pressure. Having determined K(nu) and knowing atmospheric pressure and path length of the laser light, one can obtain the concentration of the gas in question. Infrared absorption lines of N_2O, SO_2, and H_2S are observed from low pressure (equal or approximately equal 0.1 torr) to a total pressure of one atmosphere when mixed with room air. The analytical parameters S and γ are determined for some lines of N_2O, and nu_0, S, and γ are determined for several absorption lines of SO_2. Also values of nu_0 are obtained for several H_2S absorption lines.

33492 (IS-T—803) **Multielement flame emission spectroscopy using a scanning Fabry—Perot interferometer.** Korba, G.A. (Ames Lab., Iowa (USA)). Apr 1978. Contract W-7405-ENG-82. 89p. Dep. NTIS, PC A05/MF A01.

Thesis.

A system for multielement flame emission analysis based on a scanning Fabry-Perot interferometer is described and evaluated. Detection limits and linearity of response for ten elements commonly determined by flame photometry compare favorably to conventional single-element methods. Analyses for several elements in tap water, serum, urine, NBS SRM 1571 orchard leaves and low alloy steel demonstrate the excellent accuracy and precision of the technique. Resolution of the system allows up to five elements to be determined simultaneously.

33493 (Y—2111) **Automated fluorometer for uranium analysis.** McElhaney, R.J.; Caylor, J.D.; Cole, S.H.; Futrell, T.L.; Giles, V.M. (Oak Ridge Y-12 Plant, Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 16p. Dep. NTIS, PC A02/MF A01.

An utomated fluorometer has proven to be a valuable analytical tool for analyzing natural waters for the Uranium Resource

Evaluation (URE) project. Uranium is isolated from potential quenching ions and concentrated by extraction with tri-n-octylphosphine oxide (TOPO) in Varsol. A portion of the extract is placed on a sodium fluoride pellet which is then dried, sintered, and cooled. Sixteen samples can be analyzed in about 1.5 hours. The lower reporting limit has been set at 0.20 micrograms per liter (μg/l).

SEPARATION PROCEDURES

REFER ALSO TO CITATION(S) 32819, 32826

33494 (IS-T—802) **Distribution of naphthalene between commercial resins and water—methanol solutions.** Chu, F.K.C. (Ames Lab., Iowa (USA)). Dec 1977. Contract W-7405-ENG-82. 32p. Dep. NTIS, PC A03/MF A01.

Thesis.

Several XAD resins, two of their chemically modified derivatives, and two carbon absorbents were evaluated by measurement of distribution coefficients using the batch method. Numerical comparison of distribution data and graphical interpretation of these resins were also presented. The distribution differences were explained in terms of resin structure and solvent compositions. Naphthalene was the solute for the study, and methanol the solvent. It was found that Spherocarb, a newly developed carbon adsorbent, had very large distribution coefficient. However, in the application for separation, desorption can conceivably be a problem. Distribution data collected can be a valuable aid in the choice of adsorbent, solvent composition and other operating conditions in separation work.

33495 (UCD—472-124, pp 24-33) **Analysis of the organic constituents of coal fly ash, coke, and coal tar.** Jennings, W.G.; Sucre, L.; Fisher, G.L.; Raabe, O.G. Oct 1977.

In Annual report, fiscal year 1977.

Samples of coal fly ash, coke, and coal tar were fractionated and analyzed for organic constituents with a gas chromatograph adapted to high-resolution glass capillary columns. Preliminary tests yielded well-resolved chromatograms, and several polynuclear aromatic hydrocarbons have been distinguished in the samples.

33496 **Method of separating hafnium from zirconium.** Megy, J.A. (to Teledyne Industries, Inc.). US Patent 4,072,506. 7 Feb 1978. Filed date 17 Oct 1975. 12p.

A method for separating hafnium and zirconium is disclosed in which unseparated zirconium and hafnium are dissolved in the molten state in a solvent metal, preferably zinc. This molten metal phase is contacted with a fused salt phase which includes a zirconium salt as one of its components. The desired separation is effected by mutual displacement, with hafnium being transported from the molten metal phase to the fused salt phase, replacing zirconium in the salt, while zirconium is transported from the fused salt phase to the molten metal phase. Separation factors of 300 or more per stage are achieved.

33497 **Reverse phase ion-pairing chromatography at pressures up to 345 MPa.** Prukop, G.; Rogers, L.B. (Univ. of Georgia, Athens). *Sep. Sci.;* **13**: No. 1, 59-78(Jan 1978).

The effects of pressure up to 345 MPa (50,000 psi) on a reverse phase ion-pairing system were studied in 50 percent methanol-water. Retention increased by a factor of 3.2 for methyl orange when the pressure was increased to 241 MPa (30,000 psi) and still larger (not measurable) at 345 MPa (50,000 psi). The retention of methyl red was increased by a factor of 2.2 by pressures of 241 MPa (30,000 psi) and by a factor of 2.5 by 345 MPa (50,000 psi). When the methanol concentration was increased to 75 percent, retention of methyl orange increased by a factor of 2.6 between 68.9 MPa (10,000 psi) and 345 MPa (50,000 psi). Other variables studied were concentration of counterion and temperature. For methyl orange, retention decreased with pH, whereas for methyl red it increased. The effect of tetrahexylammonium ion concentration on retention was linear in the working range 0.5 to 2.0 mM. All samples eluted faster with increased temperature. two tables, 12 figures.

33498 **Plant for obtaining pure water from sea water by multistage flash evaporation.** Tidball, R.A. (to Aerojet-General Corp., El Monte, Calif. (USA)). German(FRG) Patent 1,642,440/C/. 14 Oct 1976. 7p. (In German).

The invention deals with the improvement of a multistage flash evaporation plant for the distillation of salt or turbid water in which the heat added to the process is made use of to a maximum and which leads to a very high degree of purity of the water (10 to 25 ppm impurities). In the condensation stage to which the crude water is added, the collector tanks for the condensate are connected to the evaporation chambers of the following sequence of stages by pipelines. The addition takes place via the following series of condensers and heat exchangers. A number of variations are discussed.

INORGANIC AND PHYSICAL CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

REFER ALSO TO CITATION(S) 33755

33499 (ORO—1797-78) **Lanthanide croconate complexation in solution.** Choppin, G.R.; Orebaugh, E. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1977. Contract EY-76-S-05-1797. 15p. Dep. NTIS, PC A02/MF A01.

The thermodynamic parameters of complexation of lanthanide cations by croconate ligands have been measured in aqueous solution using potentiometry and calorimetry. Comparison of experimental and calculated (with a modified Born equation) values of ΔG indicates the presence of aromatic pi systems in the carbon rings of the ligands in squarate, croconate and tropolonate complexes but of a nonaromatic pi system in the cyclic ether rings of kojate and maltolate complexes.

33500 **Photochemistry of NO_3 and the kinetics of the N_2O_5—O_3 system.** Graham, R.A.; Johnston, H.S. (Univ. of California, Berkeley). *J. Phys. Chem.;* **82**: No. 3, 254-268(9 Feb 1978).

The kinetics of the nitrogen pentoxide catalyzed decomposition of ozone were studied in the dark and with photolytic light absorbed by the NO_3 radical. Ultraviolet, visible, or infrared absorption cross sections were measured for N_2O_5, HNO_3, NO_2 and NO_3. The equilibrium constant for N_2O_5 reversible $NO_2 + NO_3$ was found to be (molecules cm^{-3}, 298—329 K) $K = (8.4 +- 1.8) \times 10^{26} \exp[-(11180 +- 100)/T]$. The rate constants for several reactions were measured: (cm^3 molecule^{-1}s^{-1}) $2NO_3 \rightarrow 2NO_2 + O_2$, $g = (8.5 +- 2.8) \times 10^{-13} \exp[-(2450 +- 100)/T]$; $O + N_2O_5 \rightarrow$ product, m less than or equal to 2×10^{-14}; $O + NO_3 \rightarrow O_2 + NO_2$, $n = (1.0 +- 0.4) \times 10^{-11}$. By combining the equilibrium constant K with literature values of Ke and Kf, rate constants for reactions e and f were evaluated: $NO_2 + NO_3 \rightarrow NO + O_2 + NO_2$, $e = (2.5 +- 0.5) \times 10^{-14} \exp[-(1230 +- 100)/T]$; $NO + NO_3 \rightarrow 2NO_2$, $f = (1.9 +- 0.4) \times 10^{-11}$ at 297 K. At 1 atm total pressure, the photolysis of NO_3 occurs with a primary quantum yield less than one in the red region of the spectrum. The solar photolysis constants at 298 K for the two paths of dissociation are consistent with the following values: $NO_3 + h\nu \rightarrow NO + O_2$, $j_1 = 0.040 +- 0.02\ s^{-1}$; $NO_3 + h\nu \rightarrow NO_2 + O$, $j_2 = 0.099 +- 0.02\ s^{-1}$. The average quantum yield for process two was approximately 0.77 for light with wavelengths between 470 and 610 nm, and that for process one was about 0.23 between 470 and 610 nm but only 0.07 in the strong absorption region between 610 and 670 nm. The photolysis constants may be larger at lower total pressures. Infrared absorption ascribed to NO_3 is due to N_2O_5; previously reported visible cross sections for NO_3 were found to be about a factor of 4 too low and are corrected here; previously reported ultraviolet cross sections for N_2O_5 are reversed slightly.

33501 **XPS spectra and crystalline potentials in alkaline-earth chalcogenides and hydrides.** Franzen, H.F. (Ames Lab., IO); Merrick, J.; Umana, M.; Khan, A.S.; Peterson, D.T.; McCreary, J.R.; Thorn, R.J. *J. Electron Spectrosc. Relat. Phenom.;* **11**: 439-443(1977).

The results of x-ray photoelectron spectroscopy studies of alkaline earth hydrides are reported to provide information about the nature of the distribution of electron density in the hydrides relative to the elements. The binding energies of both Ca and Sr compounds were found to decrease with increasing atomic number of the element, and the differences follow the same trend as do the electronegativities of the elements. Although the calculated charges might be subject to question, because of the method used to obtain the site potential; the conclusion that CaH_2 is a strongly ionic solid is clearly indicatd by the data. (BLM)

33502 **Redox reactions in the XeF_2/platinum fluoride and XeF_2/palladium fluoride systems and the conversion of XeF_2 to XeF_4 and Xe.** Bartlett, N.; Zemva, B.; Graham, L. (Univ. of California, Berkeley). *J. Fluorine Chem.;* **7**: 301-320(1976).

Liquid XeF_2 at 140 to 150^0 oxidizes PtF_4: $5XeF_2 + 2PtF_4 \rightarrow 2Xe_2F_3PtF_6 + Xe$ up arrow. The salt $Xe_2F_3^+ PtF_6^-$ loses XeF_2 at 70^0 in vacuo: $Xe_2F_3PtF_6 \rightarrow XeFPtF_6 + XeF_2$ up arrow. Pyrolysis of $XeF^+ PtF_6^-$ at 150 to 160^0 yields XeF_4: $XeFPtF_6 \rightarrow XePt_2F_{10} + XeF_4$ up arrow. The complex $XePt_2F_{10}$ loses XeF_2 at 430^0: $XePt_2F_{10} \rightarrow PtF_4 + XeF_2$ up arrow. $XePt_2F_{10}$ also can be oxidized by liquid XeF_2 at 140 to 150^0: $XePt_2F_{10} + 4XeF_2 \rightarrow 2Xe_2F_3Pt_6 + Xe$ up arrow. The paramagnetic mixed-valence fluoride Pd_2F_6 is oxidized by XeF_2(l) at 140 to 150^0: $Pd_2F_6 + 3XeF_2 \rightarrow 2XePdF_6 + Xe$ up arrow. The yellow diamagnetic $XePdF_6$, which is thermally stable at room temperature, loses XeF_2 at 140 to 150^0: $2XePdF_6 \rightarrow XePd_2F_{10} + XeF_2$ up arrow. Both $XePdF_6$ and $XePd_2F_{10}$ may be derived from $XeF_2 + PdF_4$. The complex $XePd_2F_{10}$ is a close structural relative of $XePt_2F_{10}$ and spectroscopic evidence suggests that both are salts of XeF^+ and a polymeric (M_2F_9)/sub x//sup x$^-$/ ion. Pyrolysis of $XePd_2F_{10}$ at 280^0 yields XeF_4: $XePd_2F_{10} \rightarrow Pd_2F_6 + XeF_4$. 6 tables, 5 figures.

33503 Importance of accelerating thermodynamic compilation endeavors. Brewer, L. (Lawrence Berkeley Lab., CA). *CODATA Newsl.;* No. 13, 6-9(Sep 1974).

Efforts since 1920 in the compilation of thermodynamic data are reviewed very briefly. The reasons for the failure of thse efforts to keep pace with the accumulation of experimental data and a few requirements for closing this gap between data procurement and compilation are pointed out. The main portion of the paper is devoted to a discussion of the role of models as an aid in evaluating experimental thermodynamic data for compilation. Specific examples are used to illustrate the role of the model in compilation. The relevance of such a compilation method in compiling thermodynamic data and predicting the missing data in solution of our energy problems is discussed. (BLM)

ISOTOPE EFFECTS

REFER ALSO TO CITATION(S) 33433

ISOTOPE EXCHANGE AND ISOTOPE SEPARATION

REFER ALSO TO CITATION(S) 32858

ORGANIC CHEMISTRY

CHEMICAL AND PHYSICOCHEMICAL PROPERTIES

33504 (SAN—34P218X4) **Multiheteromacrocycles that complex metal ions. Fourth progress report, 1 May 1977—30 April 1978.** Cram, D.J. (California Univ., Los Angeles (USA). Dept. of Chemistry). 15 Jan 1978. Contract EY-76-S-03-0034-218. 24p. Dep. NTIS, PC A02/MF A01.

Results are reported in a program to design, synthesize, and evaluate polycyclic host organic compounds for their abilities to complex and lipophilize guest metal ions. Work during the reporting period was devoted to synthesis and study of cyclohexametaphenylenes and cyclic phosphine oxides. (JRD)

33505 Ab initio quantum mechanical characterization of the ground electronic state of uracil. O'Donnell, T.J. (Univ. of Illinois, Chicago); LeBreton, P.R.; Shipman, L.L. *J. Phys. Chem.;* **82**: No. 3, 343-347(9 Feb 1978).

The ground electronic state of uracil was characterized by the ab initio molecular fragment floating spherical Gaussian orbital method. Among the properties studied were ionization potentials, permanent diople moment, the electronic charge distributions of the higher occupied and lowest unoccupied molecular orbitals, the populations and bond orders which describe the total π-electronic charge distribution, and the dipole binding energies of the three hydrogen bonding sites of uracil that are available for base pairing in RNA. A linear relation was found between the calculated orbital energies and the one-electron ionization potentials measured by uv photoelectron spectroscopy. At the x-ray crystallographic geometry, the permanent dipole moment was calculated to have a length of 2.27 D and to form an angle of 27° with the $C_4 \rightarrow N_1$ direction. When the unusually short C-H and N-H bonds in the x-ray structure of uracil were lengthened to 1.10 and 1.00 A, respectively, the calculated dipole moment changed to 3.55 D and formed an angle of 38° with the $C_4 \rightarrow N_1$ direction. The lowest unoccupied molecular orbital is a π-antibonding molecular orbital while the highest occupied molecular orbital is π nonbonding. The lowest unoccupied molecular orbital has a very high virtual electron density at the C_6 atom and there are nodes between the C_6 atom and the N_1 and C_5 atoms; these two factors combine to make the C_6 atom highly susceptible to "focused" nucleophilic attack. No single resonance structure can adequately represent the total π-electron charge distribution which has a net bond order of approximately 4.4 π bonds. The oxygen atom attached to position 4 of the ring is a better hydrogen bonding site than the oxygen attached to position 2.

33506 (LA-tr—78-19) **Conformational state of bradykinin and its analogs in solutions. II. Fluorescence spectra.** Efremov, E.S.; Filatova, M.P.; Reutova, T.O.; Stepanova, L.N.; Reyssmann, Z.; Ivanov, V.T. Translated from *Bioorg. Khim.;* **3**: No. 9, 1169-1179(1977). 20p. Dep. NTIS, PC A02/MF A01.

Fluorescence spectra of derivatives of bradykinin and its contracted analogs with fluorescent labelling in the first (Dns), fifth and eighth (Phe, Tyr, Prp) positions are investigated. Interchromophore distances 1-5, 1-8 and 5-8 in aqueous (+25°) and alcohol (+25° and -25°) solutions are measured according to the efficiency of the radiationless transfer of energy. Two methods of measuring the effectiveness of transfer are used: integral intensity of emission spectra and corrected spectra of excitation. The distance values obtained make it possible to formulate a hypothesis as to participation in conformational equilibrium of bradykinin conformers with adjacent N-C-ends.

33507 (LA-tr—78-20) **Conformational states of bradykinin and its analogs in solution. I. Circular dichroism spectra.** Ivanov, V.T.; Filatova, M.P.; Reissmann, Z.; Reutova, T.O.; Chekhlyaeva, N.M. Translated from *Bioorg. Khim.;* **3**: No. 9, 1157-1168(1977). 21p. Dep. NTIS, PC A02/MF A01.

The circular dichroism (CD) spectra of bradykinin in solutions of different polarities, and a wide range of temperatures, pH, concentrations, and ionic strengths are studied. Also studied is a series of synthetic analogs of bradykinin with modifications of the α-amino group (SL-Arg^1), the aromatic rings (Cha^5, Cha^8, $Cha^{5,8}$, Tyr^5, Tyr^8), the peptide bond (Glc^4, Glc^6, Pla^8), the aromatic ring and peptide bond simultaneously (Cla^8), and the amino acid residue Ser (Gly^6). On the basis of the data obtained, a hypothesis was put forth on the presence of at least two related spatial configurations in the conformational equilibrium of bradykinin in solutions, possessing a folded type of structure, with the PHI, PSI-parameters of the majority of amino acid residues corresponding to the B region of conformational maps. The results of the study of bradykinin analogs conform with the retention in them of the spatial structure of the parent hormone, by and large, with the exception of the analog [Glc^4]-bradykinin with its sharply reduced biological activity.

33508 (LA-tr—78-22) **Conformational states of bradykinin in solution. Calculation of stable conformations.** Galaktionov, S.G.; Sherman, S.A.; Shenderovich, M.D.; Nikiforovich, G.V.; Leonova, V.I. Translated from *Bioorg. Khim.;* **3**: No. 9, 1190-1197(1977). 15p. Dep. NTIS, PC A02/MF A01.

A complete conformational analysis of the bradykinin molecule has been performed in the pair-additive approximation. The energy of hydration was taken into account according to Hopfinger. The computation was based on previously developed, specialized algorithms, in particular, of the search procedure for the global minimum energy of near-neighbor intramolecular interactions. It was determined that the conformational mobility of the peptide backbone of the molecule is determined mainly by the "flexible" Pro^3-Gly^4 fragment. Eight types of the most stable conformations of the bradykinin molecule were described. Four of them are characterized by a pseudo-cyclic structure, by means of formation of an intramolecular ionic bond of the Arg^1-NH-$C(NH_2)_2^+$ . . . -OOC-Arg^9 type.

33509 (LA-tr—78-29) **Conformational states of bradykinin and its analogs in solution. III. Electron paramagnetic resonance spectra of its spin-labeled analogs.** Filatova, M.P.; Reysmann, Z.; Reutova, T.O.; Ivanov, V.T. Translated from *Bioorg. Khim.;* **3**: No. 9, 1181-1189(1977). 15p. Dep. NTIS, PC A02/MF A01.

A series of spin-labeled derivatives of bradykinin and its shortened analogs with nitroxyl radicals in the 1, 5, 6, and 8 positions was investigated by an electron spin resonance method. The mean distances between paramagnetic nitroxyl centers introduced in the first and fifth, first and sixth, first and eighth, and fifth and eighth amino acid residues were determined in glasslike solutions at -196° from dipole-dipole interactions. Bradykinin at conformational equilibrium was hypothesized, as a result, to contain conformational isomers with bent or pseudocyclic structure with adjacent N- and C-ends.

ISOTOPE EFFECTS

33510 Proton inventories of a serine protease charge-relay model in an aprotic solvent. Hogg, J.L.; Morris, R. III; Durrant, N.A. (Texas A and M Univ., College Station). *J. Am. Chem. Soc.;* **100**: No. 5, 1590-1594(1 Mar 1978).

Solvent isotope effects in H_2O-D_2O mixtures have been used to probe the operation of a catalytic system which has been suggested as a model for the charge-relay chain of serine protease enzymes. The absence of any significant solvent isotope effects coupled with the shapes of the proton inventories rules out any significant proton transfer mechanisms for the imidazole promoted or imidazole-benzoate anion promoted reaction of p-nitrophenyl acetate in acetonitrile containing 1 M H_2O. In the present study it was shown that the observed reaction is not hydrolysis as previously suggested. Nucleophilic attack by hydrogen-bonded dimers is proposed as the mechanism of catalysis.

ELECTROCHEMISTRY

33511 (AD—045339) **Extended abstracts of the biennial Air Force electrochemistry conference (4th). Technical report.** Hussey, C.L.; King, L.A. (Frank J. Seiler Research Lab., United States Air Force Academy, Colo. (USA)). Aug 1977. 59p. (FJSRL-TR—77-0013). NTIS PC A04/MF A01.

Abstracts of presentations given at the 4th Biennial Air Force Electrochemistry Conference, 28-29 April 1977, are compiled.

PHOTOCHEMISTRY

REFER ALSO TO CITATION(S) 33500

33512 Design and study of a photosensitive interface: a derivatized n-type silicon photoelectrode. Wrighton, M.S.; Austin, R.G.; Bocarsly, A.B.; Bolts, J.M.; Haas, O.; Legg, K.D.; Nadjo, L.; Palazzotto, M.C. (Massachusetts Inst. of Tech., Cambridge). *J. Am. Chem. Soc.;* **100**: No. 5, 1602-1603(1 Mar 1978).

We previously found that the photoanodic decomposition of n-type Si can be suppressed by the competitive oxidation of ferrocene in EtOH solution with $[n\text{-}Bu_4N]ClO_4$ as the supporting electrolyte. Such studies have led us to suspect a strong interaction of the stabilized photoanode with the reductant added to the solution. We now report the covalent attachment of a photoelectrochemically active ferrocene derivative to the surface of n-type Si which passivates the electrode to decomposition (SiO_2 formation). This study opens a new avenue for the stabilization of semiconductor/liquid junction photocells.

33513 Electron spin resonance investigation of charge transfer in aromatic peptide π-cation radicals. Sevilla, M.D.; D'Arcy, J.B. (Oakland Univ., Rochester, MI). *J. Phys. Chem.;* **82**: No. 3, 338-342(9 Feb 1978).

Radicals produced by the photoionization of aromatic dipeptides in neutral (8M $NaClO_4$) and basic (8M NaOD) glasses at 77K were investigated by ESR spectroscopy. For L-phenylalanyl-L-alanine and L-phenylalanylglycine photoionization in 8M $NaClO_4$ glasses resulted in decarboxylated radicals of the form approximately CO-ND-CHR. In the cases of L-tyronyl-L-alanine, L-tyrosylglycine, L-tryptophyl-L-alanine, and L-tryptophylglycine in 8M $NaClO_4$, both decarboxylated radicals and radicals on the aromatic groups are observed. The aromatic group radicals are found to be the phenoxyl radical in tyrosine containing peptides and the indole π cation in the tryptophan containing peptides. Photoionization of the aromatic peptides in 8M NaOD results in only aromatic group radicals for phenylalanine and tryptophan containing peptides, whereas both decarboxylated and aromatic group radicals are noted in tryosine containing peptides. For phenylalanylalanine a study of decarboxylated radical vs. light intensity shows that the radical is produced by a biphotonic process. A concentration study shows the transfer of charge from the photoionized aromatic group to the carboxyl group is intramolecular in nature. Results found for the individual aromatic amino acids and a tripeptide which shows only the aromatic group radicals suggest that the transfer of charge is strongly conformationally dependent.

RADIATION CHEMISTRY

REFER ALSO TO CITATION(S) 33698, 33909

33514 (ORO—4059-7) **Radiation chemistry of high polymers. Final report.** Dole, M.; Welch, R.A. (Baylor Univ., Waco, Tex. (USA)). 1977. Contract EY-76-S-05-4059. 28p. Dep. NTIS, PC A03/MF A01.

Work on calibrating the radiation intensity in our γ-ray source as a function of height and horizontal displacement was completed. For extended chain (high crystallinity) polyethylene (PE) before and after quenching from the melt irradiated at room temperature, the crosslinking yield increased twofold on lowering the crystallinity from 96 to 70%. The G-value for alkyl radical production was about 75% higher in the quenched extended chain sample as compared to the value before quenching. The G (alkyl) values were determined for irradiations at 77K. The rate of decay of the alkyl radicals in PE samples of single crystals having different stem lengths was studied at 80 and 85°. It was found that the mole fraction of the slowly decaying free radicals increased with the stem length. Hydrogen gas was found to catalyze both the slow and fast decays. Because hydrogen does not dissolve in the crystalline regions of the PE, the catalytic effect must occur at the amorphous boundary of the crystalline stems. With respect to the kinetics of the allyl radical, either it was found that the data could be explained in terms of two simultaneous but spatially separated second order reactions. As the temperature is raised to 135°, the two reactions merge into one. Hydrogen gas has no effect on the decay of the allyl radicals. In the case of the highly crystalline extended chain samples, the allyl decay in some cases follows the simple kinetic equation $(1/c) - (1/c_0) = k\sqrt{t}$, where k is called a time independent diffusion controlled reaction rate constant. The less the crystallinity of the sample the greater the k constant. A preliminary study of isotactic polypropylene (PP) was carried out and a definite hydrogen gas catalysis of the free radical decay in PP was seen. Similarly in crystalline l-leucine the hydrogen catalytic effect could also be clearly demonstrated.

33515 Reaction of e/sub aq/-into excited states of $Ru(bpy)_3^{2+}$. Jonah, C.D.; Matheson, M.S.; Meisel, D. (Argonne National Lab., IL). *J. Am. Chem. Soc.;* **100**: No. 5, 1449-1456(1 Mar 1978).

In the reaction of e^-/sub aq/ with $Ru(bpy)_3^{3+}$ it was found that 38% of e^-/sub aq/ yields $(CT)Ru(bpy)_3^{2+*}$, the well-known, luminescent lowest charge transfer state of $Ru(bpy)_3^{2+}$. More than 55% of e^-/sub aq/ (that is, almost all of the remainder) yields another excited state or a coordinated radical complex, which is longer lived than $(CT)Ru(bpy)_3^{2+*}$ and does not convert to it. A very small fraction of e^-/sub aq/ (<7%) is transferred directly to the ground state. While $(CT)Ru(bpy)_3^{2+*}$ decays to the ground state both by first-order conversion and through quenching by $Ru(bpy)_3^{3+}$, the other product decays to $Ru(bpy)_3^{2+}$ almost solely (under our conditions) through a reaction with $Ru(bpy)_3^{3+}$. The lack of a significant direct reaction to the ground state is rationalized as an example of the slow electron transfers to be expected for highly exergonic reactions in the "inverted" region of the Marcus theory. H atoms, Cd^+, and $Ru[bpy)_3^+$ were found to react with $Ru(bpy)_3^{3+}$ to yield the divalent ground state directly.

33516 Method for radiation production of fuels. Lee, R.A. (to Texas Gas Transmission Corp.). US Patent 4,064,024. 20 Dec 1977. Filed date 1 Jun 1976. 4p.

The invention disclosed provides a new improved chemical method for combustible fuel production by radiolysis of carbon dioxide in the presence of sulfur hexafluoride and NO_2. The dissociated products of carbon monoxide and oxygen may be recovered and used to produce hydrogen gas which can be converted to combustible fuels e.g. methane and methanol.

33517 Long-lived parent negative ions formed via nuclear-excited feshbach resonances. Part V. Effective number of degrees of freedom participating in the sharing of the ion's excess energy. Christophorou, L.G.; Gant, K.S.; Anderson, V.E. (Oak Ridge National Lab., TN). *J. Chem. Soc. (London), Faraday Trans., II;* **73**: 804-811(1977).

The autodetachment lifetime of the long-lived parent negative ion of hexafluorobenzene (C_6F_6) has been calculated theoretically and found to decrease with increasing electron energy. A comparison of the calculated and the measured lifetimes of the $C_6F^-{}_6{}^*$ ion indicated that only approximately 30% of the possible modes of vibration effectively participate in the sharing of the ion's excess energy.

RADIOCHEMISTRY AND NUCLEAR CHEMISTRY

PROPERTIES OF RADIOACTIVE MATERIALS

33518 (DP—1484) **Kinetics of the ambient temperature dissolution of plutonium metal in sulfamic acid.** Gray, L.W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Mar 1978. Contract EY-76-C-09-0001. 18p. Dep. NTIS, PC A02/MF A01.

The stoichiometry and the kinetics of the ambient temperature dissolution of alpha-phase plutonium in sulfamic acid has been determined. Hydrogen off-gas rates and plutonium concentrations were calculated as functions of time for a variety of dissolving conditions. Calculations show that nominal 2.2 kg Pu buttons (surface area, 171 cm^2) should yield solutions containing 60 +- 10 g Pu/L after a one-hour dissolving cycle. Hydrogen off-gas rates were calculated to vary from as high as 780 mL of gaseous hydrogen per minute (STP) at the beginning of a dissolving cycle to as low as 150 mL H_2(g) per min near the end of a dissolving cycle.

33519 Method for reducing uranium tetrafluoride. Heidt, H.M. (to Babcock and Wilcox Co.). US Patent 4,051,227. 27 Sep 1977. Filed date 28 Jun 1976. 4p.

A pulsed flow process is described for the reduction of UF_6 where the process may be continuous or batch starting without a seed bed. The initial amplitude and frequency of the pulsed flow is altered as a bed of particle-form material is formed and thereafter the particle-form product of the reaction is removed from the reaction zone.

COMBUSTION CHEMISTRY

REFER ALSO TO CITATION(S) 32861, 32862

ENGINEERING

GENERAL ENGINEERING

33520 (MHSMP—78-3) **Recycling TATB PBX.** Osborn, A.G.; Stallings, T.L.; Johnson, H.D. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). Feb 1978. Contract EY-76-C-04-0487. 9p. Dep. NTIS, PC A02/MF A01.

The feasibility of recycling IHE has been successfully demonstrated on a large scale by processing over 750 kg of machining scrap. The content of machine cuttings in the recycled PBX lots was 50, 75, and 100%. Physical strengths were generally above normal and tensile strains were 0.29% or better.

FACILITIES AND EQUIPMENT

REFER ALSO TO CITATION(S) 33652

33521 (BDX—613-1764) **Computer simulation of the mold heating and cooling control loop, using conventional control strategies.** Floersch, R.H. (Bendix Corp., Kansas City, Mo. (USA)). Feb 1978. Contract EY-76-C-04-0613. 167p. NTIS, MF A01.

Portions of document are illegible.

Mathematical models of the mold and fluid temperature responses were developed experimentally. Those models were then used with a digital computer simulation program in an effort to duplicate mathematically the physical plant dynamic response. The simulation program underwent a series of evolutionary steps until satisfactory duplication of the processes existed. Various control strategies were then simulated. The evolution of the simulation program and the simulation results are presented.

CRYOGENIC AND SUPERCONDUCTING EQUIPMENT AND DEVICES

REFER ALSO TO CITATION(S) 32986, 32987, 33616, 33628, 34254, 34255, 34256, 34257, 34258, 34259, 34261, 34262, 34263, 34264, 34265

33522 (LA—7134-PR) **Low temperature physics and engineering quarterly progress report, July 1—September 30, 1977.** Keller, W.E. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 38p. Dep. NTIS, PC A03/MF A01.

A summary is given of the significant progress achieved in several programs carried out in the Los Alamos Scientific Laboratory's Low Temperature Physics and Cryogenic Engineering Group (Q-10) during the period July 1 to September 30, 1977. Progress is documented for the following areas: analysis of safety and hazards associated with transporting liquid hydrogen by truck, pipeline, and rail; equation of state of solid and fluid hydrogen and deuterium; magnetic studies of solids at low temperature; experiments dealing with the destruction of superconductivity by current; electrical engineering, cryogenic engineering, and cable development aspects leading to a prototype demonstration of a direct current superconducting power transmission line; development of conductors, electrical control apparatus, large dewar vessels, and electrical insulation for superconducting magnetic energy storage devices, as well as designs of these units for power system stabilization; design, testing, and procurement of equipment for separating and handling large amounts of tritium—deuterium mixtures for equipment to be used in conjunction with the magnetic fusion programs; experiments related to target preparation for the laser fusion programs; development of practical conductors of Nb_3Ge; and experiments leading to designs for magnetic refrigerators to be used for superconducting device applications in the electric power industry.

33523 (NBS—77-04) **Superconducting devices and materials. A literature survey issued quarterly, October—December 1977. Issue No. 77-04.** Olien, N.A. (comp.). (National Bureau of Standards, Boulder, Colo. (USA). Cryogenics Div.). 1977. 69p. Bureau of Standards, Boulder, CO.

Highlights of the literature on superconducting devices and materials are followed by a bibliography of approximately 500 references. The references are arranged according to subject. (TFD)

33524 (NTIS/PS—77/0913) **Superconducting magnets. Volume 1. 1964-August 1976 (a bibliography with abstracts). Report for 1964-aug 76.** Reimherr, G.W. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 251p. NTIS PC N01/MF N01.

The cited reports include research on materials studies, theory, design, and applications of superconducting magnets. Examples of the applications include particle accelerators, MHD power generation, superconducting generators, nuclear fusion research devices, energy storage systems, magnetic levitation, and bioinstrumentation. The updated bibliography contains 246 abstracts, none of which are new entries to the previous edition.

33525 (NTIS/PS—77/0914) **Superconducting magnets. Volume 2. September 1976 — September 1977 (a bibliography with abstracts). Report for Sep 76 — Sep 77.** Reimherr, G.W. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 127p. NTIS PC N01/MF N01.

The cited reports discuss research on materials studies, theory, design, and applications of superconducting magnets. Examples of applications include particle accelerators, MHD power generation, superconducting generators, nuclear fusion research devices, energy storage systems, and magnetic levitation. The updated bibliography contains 122 abstracts, all of which are new entries to the previous edition.

33526 (UCRL—13676) **Superconductor design study. Final report.** (Supercon, Inc., Natick, Mass. (USA)). 1 Apr 1976. Contract W-7405-ENG-48. 21p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

The objective of this program was to continue the developmental effort aimed toward production of a composite conductor capable of carrying 10,000 A at 12 T and suitable for use in large fusion magnets. This program pertains specifically to the development of Nb_3Sn multifilamentary conductors containing tubular Nb filaments with Cu-Sn alloy cores in a high conductivity copper matrix. The specific tasks include: (1) Fabricate 1000 ft of 1000 A, 12 T conductor for coil evaluation. (2) Fabricate several lengths of 3500 A, 12 T conductors for evaluation. These samples are to contain the required copper and reinforcing material for use in a large coil. (3) Perform further experiments to optimize T/sub c/ with respect to Nb, Nb-1%Zr and the percent Sn composition in the bronze alloy. (4) Fabricate a 150 ft long sample of the optimum 3500 A, 12 T conductor following completion of Tasks 1, 2, and 3. (5) Fabricate several short test samples of 10,000 A, 12 T conductor for short sample and mechanical strain testing. (6) Furnish complete report containing the results of all tests performed, all metallurgical data and detailed descriptions of fabrication techniques used.

33527 **Fatigue tests with small coils of filamentary Nb_3Sn.** Larbalestier, D.C.; Hong, S.O. (Univ. of Wisconsin, Madison). pp 1260-1262 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Small test coils of FM Nb_3Sn have been cyclically stressed in tension and compression while carrying current in an external magnetic field. The results obtained show that for tensile stresses up to 250 MPa (36 ksi) no change in critical current is obtained. Some implications of the results for coil construction are discussed.

33528 **Fermilab experience on large superconductor purchases and its implication to the fusion program.** Strauss, B.P.; Remsbottom, R.H.; Flora, R.H. (Fermi National Accelerator Lab., Batavia, IL). pp 1271-1272 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

It was found that the performance of built-up cables can be easily predicted from the performance of the components. Welds of individual wires within the cable are not detectable electrically when the strands are copper stabilized. Cables can be optimized for performance when strand properties are known.

33529 **Fourteenth international conference on low temperature physics (LT 14).** Kartascheff, N. (Bayerische Akademie der Wissenschaften, Garching/Muenchen (Germany, F.R.). Zentralinstitut fuer Tieftemperaturforschung). *Kaelte (Hamburg);* **29**: No. 6, 253-259(1976). (In German).

A report is given on the Helsinki congress of 1975 including a description of superconducting materials and their properties. Important criteria are: High transition temperature and high critical magnetic field strength. Of interest for technical applications are: Vanishing d.c. resistance and very low a.c. losses with small magnetic fields, while ultralow temperatures of 20 K and less are required. Only large-scale equipment is economical. The high magnetic fields made possible by superconductivity have the following applications: Synchronous generators, homeopolar generators, magnetic suspension railways, energy storage as an alternative to pumped-storage power plants, magnetic separation plants, high-power cables and telephone lines.

HANDLING EQUIPMENT AND PROCEDURES

33530 **Changing nature of nuclear transport.** Brobst, W.A. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Waste Management and Transportation). pp 3-8

of Transport packaging for radioactive materials. Vienna; IAEA (1976).

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

See CONF-760813—.

The IAEA's efforts in transport safety have been proven through 25 years of nearly accident-free transport, with no evidence of death or injury from the nuclear characteristics of those shipments. Much testing has been done over the last five years to verify the technical bases for the IAEA Regulations. Rather than being complacent with the past, we should instead see ourselves at a turning point for the solution of problems coming up in the next few years. The number of shipments will increase drastically and this will result in changes of risk levels. A number of critical problems will be discussed: (1) lack of public acceptance of nuclear shipment safety; (2) transport safeguards; (3) incompleteness in the IAEA package damage tests; (4) need for innovative technology for spent fuel casks; (5) reduction of radiation dose to the public; (6) quality assurance; (7) engineering analyses versus scale-model and full-scale testing; and (8) transport controls. A recommendation is made to the IAEA to set up immediately a study group to define these problems, list alternatives and options, and recommend corrective actions.

33531 U.S. Nuclear Regulatory Commission Program to certify a package for air transport of plutonium. Chappell, C.R. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 351-357 of Transport packaging for radioactive materials. Vienna; IAEA (1976).

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

See CONF-760813—.

The Congress of the United States recently placed a restriction upon the U.S. Nuclear Regulatory Commission (NRC) requiring the NRC to prohibit air transport of plutonium by its licensees until the NRC certifies 'that a safe container has been developed and tested which will not rupture under crash and blast-testing equivalent to the crash and explosion of a high-flying aircraft.' The paper outlines a deterministic type assessment that is being made of aircraft accident severities. The paper also discusses various aircraft accident conditions and the factors which tend to limit their severity. This information is being considered for possible use in developing qualification criteria for package certification.

33532 Review of five years (1971-1975) accident experience in the USA involving nuclear transportation. Grella, A.W. (Department of Transportation, Washington, D.C. (USA)). pp 225-239 of Transport packaging for radioactive materials. Vienna; IAEA (1976).

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

See CONF-760813—.

This paper summarizes the recorded accident experience during 1971-1975 in the USA involving nuclear materials transport. Since 1971, a uniform multimodal hazardous materials incident (HMI) reporting system has been in effect in the USA as a requirement of the U.S. Department of Transportation (DOT) regulations. Carriers of hazardous materials are now required to provide reports to DOT of transport incidents based on certain criteria which include death, personal injury, property damage, and in the case of radioactive materials (RAM), suspected radioactive contamination. Of the more than 32000 HMI reports submitted to DOT during the five-year period, only 144 were noted to involve RAM. Recent studies indicate that approximately 2.5 million packages of RAM are transported annually in the USA. Examination of these 144 incident reports indicated that in only 36 cases was there any indication of release of contents or excess radiation levels. In most cases, releases involved minor contamination from low specific activity, 'exempt' or Type A packages. In many incidents Type A packages had been subjected to crushing, impact, or other similar accidental conditions with no release of contents. No deaths or significant injury to persons due to radiation or radioactivity from the shipments were experienced, which is a continuation of the excellent transport safety experience which has been observed over the past 30 years of nuclear transportation. The experience observed over this five-year period appears to demonstrate and confirm the adequacy of the packaging standards in providing safety for nuclear materials in transport. Continued accumulation and analysis of such data on a world-wide basis should be carried out in order to provide the public sector with the perspective necessary to allay their fears and overcome the lack of acceptance often held by the public concerning transport of radioactive materials.

SHIPPING CONTAINERS

33533 (BNWL—2260-5) Study of plutonium oxide leak rates from shipping containers. Quarterly progress report, October 1, 1977—December 31, 1977. Schwendiman, L.C.; Pobereskin, M.; Mishima, J.; Sutter, S.L.; Madia, W.J.; Schmidt, E.W.; Drenner, D.C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 46p. Dep. NTIS, PC A03/MF A01.

The study was initiated in Oct. 1976. Several tasks are to be undertaken. In combination, they have the end objective of defining the leak rates of plutonium oxide from characterized leaks in shipping containers. Research progress is reported on each of the four tasks. (TFD)

33534 Destructive testing of transport packaging. Quality assurance applied to transport packaging in the USA. Barker, R.F. (Nuclear Regulatory Commission, Washington, D.C. (USA)). pp 359-368 of Transport packaging for radioactive materials. Vienna; IAEA (1976).

From Symposium on the design, construction and testing of packaging for the safe transport of radioactive materials; Vienna, Austria (23 Aug 1976).

See CONF-760813—.

This paper discusses several aspects of quality assurance as applied to packaging, including such requirements for an adequate quality assurance program as assignment of responsibilities, inspections, and audits. In certain cases, we have determined the margin of safety inherent in specific package designs. Testing of packaging to destruction, by subjecting it to conditions far beyond the present accident criteria, was carried out to establish the levels of impact, puncture, crush, and fire at which present designs would fail. A second area in which the Nuclear Regulatory Commission has applied quality assurance is qualification testing. The standards for testing prototypes require essentially no loss of contents under the specified accident test conditions. Qualifying a design with an acceptable degree of reliability by testing it at the specified stress levels with no measurable effect requires large numbers of samples to be tested. Testing the prototype under conditions well above the criteria is shown to offer one of the most effective means of demonstrating the adequacy of a design. Scenario tests, i.e., staged accidents or full-scale tests in which vehicles with samples of packages on board are crashed under specified conditions, in most cases present singular points on a curve. One-point tests in most cases will disprove a package design if it fails but may not confirm that a design will not fail. At the same time, much information and some public assurances can be obtained from such tests.

33535 (SAND—77-1483) Conceptual designs for LMFBR spent fuel shipping casks. Allen, G.C. Jr.; Eakes, R.G.; Freedman, J.M.; Pope, R.B.; Dupree, S.A.; Schimmel, W.P. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 44p. Dep. NTIS, PC A03/MF A01.

A spent-fuel shipping cask for use at both the Fast Flux Test Facility (FFTF) and the Clinch River Breeder Reactor Plant (CRBRP) is being developed. In compliance with milestones established for the Sandia Labs LMFBR spent-fuel shipping activity, conceptual designs of an LMFBR shipping cask are described. The detailed design based on one of the concepts will commence after review and comments have been received from the cognizant organizations. Conceptual designs described in this document comply with the shipping system requirements as defined in the LMFBR Spent-Fuel Shipping System Design Description. Additional considerations which have affected the conceptual designs currently being used are: (1) the rotating basket option has been excluded; (2) spent fuel must be adequately cooled during loading and unloading in a one-atmosphere argon environment; (3) passive cooling of the cask during shipment is required; (4) six-month cooled CRBRP fuel prescribes the radiation and thermal source; and (5) the shipping cask will be transported by rail. Heat transfer requirements during loading and unloading will substantially impact the shipping system. Spent-fuel assemblies may be placed in canisters containing a nongaseous coolant prior to shipment or may be shipped bare subject to certain loading and cooling restrictions. The recommended option is to place a liquid metal in the canister and then insert the fuel assembly.

TRANSPORT AND STORAGE FACILITIES

33536 (CONF-771092—6) Solids flow control using a nonmechanical L-valve. Knowlton, T.M.; Hirsan, I. (Institute of Gas Technology, Chicago, Ill. (USA)). 1977. 37p. of Gas Technology, Chicago, IL.

From 9. synthetic pipeline gas symposium; Chicago, IL, USA (31 Oct 1977).

Tests of the L-valve led to the following conclusions: the total aeration, Q/sub t/, which determines the flow rate of solids through an L-valve is the sum of the external aeration gas added, Q/sub ext/, and the gas carried down the downcomer with the solids; the downcomer length above the L-valve aeration tap limits the maximum solids flow rate obtainable through an L-valve; the downcomer length above the L-valve aeration location determines the

amount of external aeration, Q/sub ext/, necessary to produce a certain solids flow rate through the valve; the optimum aeration tap location for an L-valve is as close to the L-valve bend as possible (This location gives the maximum solids flow rate through the L-valve); L-valve aeration requirements increase with an increase in particle size, particle density, and vertical section diameter; and the pressure drop per foot across an L-valve increases with increasing particle density and decreasing horizontal section diameter.

MINING AND DRILLING EQUIPMENT AND FACILITIES

REFER ALSO TO CITATION(S) 32681, 32682

33537 **Method of grouting offshore structure.** Williams, K.A. US Patent 4,070,869. 31 Jan 1978. Filed date 14 Feb 1977. 4p.

A method is given for grouting an offshore structure such as the leg of an offshore platform having an outer tubular jacket and an inner tubular piling wherein grout is deposited in the annulus therebetween. The method includes introducing a tube downwardly through the annular space until the lower end of the tube is proximate the bottom of the annular space. Thereafter grout is circulated down the tubing and up the annulus to thereby displace water from the annulus and fill the same with a column of grout. Preferably, the tube is removed from the annulus before the grout hardens. In certain instances, it may be required to form a plug in the bottom of the annulus to establish circulation through the tube, up the annulus, and out at the top. In order to form such a plug, a quantity of plug forming material, such as a liquid epoxy resin composition or a quick-setting cement slurry is circulated down the tube to the bottom of the annular space and there deposited. The tube is then raised until the lower end thereof is above and proximate to the upper surface of the deposited plug forming material, which material is then allowed to harden to form a plug in the annulus. The plug forming material is of a type which is relatively quick setting compared with the grout.

33538 **Electric speed limiter for operational underground haulage equipment.** Maslii, A.K. *Sov. Electr. Eng. (Engl. Transl.);* 47: No. 6, 104-106(1976).

A circuit is given for an explosion-proof duplicating electric speed limiter of increased reliability; it is based on utilization of contactless elements and meets all safety requirements of modern underground haulage systems.

LASERS

REFER ALSO TO CITATION(S) 34292, 34296

33539 (AD—004310) **Foil moderated radioactive preionization system for gas lasers.** Leiby, C.C. Jr. (Department of the Air Force, Washington, D.C. (USA)). 19 Aug 1977. 14p. NTIS PC A02/MF A01.

radioactive preionization system is described. It has a thin metallic film or foil, either placed in front of, or deposited on the surface of radioactive sources, in order to isolate the radioactive source from laser discharge regions and to produce copious secondary emission electrons. The film or foil prevents bombardment of the radioactive source by discharge electrons and/or ions. In addition, the secondary emission electrons ejected from the metallic film or foil are more numerous than the radioactive decay particles which produce them and have lower energies. Hence, they are much more efficient preionization agents than the high energy particles emitted by the radioactive source.

33540 (AD—045092) **The single crystal growth and laser rod fabrication of Nd:YVO_4. Interim report 1 Jul 76—1 Jan 77.** Drafall, L.E.; Belt, R.F. (Litton Systems, Inc., Morris Plains, N.J. (USA). Airtron Div.). Aug 1977. Contract DAAB07-76-C-0908. 48p. NTIS PC A03/MF A01.

This project was initiated to investigate the single crystal growth and laser rod fabrication of (100) oriented Nd:YVO_4. The desired size and quality of the crystals were obtained most advantageously by Czochralski growth methods. RF heated iridium crucibles and commercially developed crystal growth equipment were used to evaluate many variables. Two growth stations were used continuously.

33541 (AD—045095) **Optical materials characterization. Semi-annual technical report 1 Feb—31 Jul 77.** Feldman, A.; Horowitz, D.; Waxler, R.M.; Dodge, M.J.; Gladden, W.K. (National Bureau of Standards, Washington, D.C. (USA)). Aug 1977. 43p. (NBSIR—77-1304). NTIS PC A03/MF A01.

The refractive index of fusion cast CaF_2 was measured at room temperature over the wavelength range 0.2144 to 8.662 mm and the data were fitted to a Selmeier type equation. Measurements of refractive index of hot forged CaF2 were extended to the wavelength range 0.2024 to 0.2483 mm. Data are presented for dn/dT of single crystal specimens of CaF_2, BaF_2, reactive atmosphere processed (RAP) KC1 and KBr, LiF, NaF, and 2SrF2, and polycrystalline chemical vapor deposited (CVD) ZnSe and ZnS. The measurements were done by the method of Fizeau interferometry over the temperature range -180 to 200° C at the wavelengths 0.6328, 1.15, 3.39 and 10.6 mm. Data are presented for the refractive indices, the linear thermal expansion and dn/dT of Lexan and Plexiglas 55.

33542 (AD—045215) **Analysis of the factors causing glow collapse in high energy electron beam sustained CO lasers. Final report 1 Jan—31 Dec 76.** Nighan, W.L.; Wiegand, W.J.; Hall, R.J.; Bullis, R.H. (United Technologies Research Center, East Hartford, Conn. (USA)). Jul 1977. Contract F33615-76-C-2046. 58p. NTIS PC A04/MF A01.

In this investigation the causes of thermal instability in high power CO laser discharges were examined. This analysis showed that externally sustained CO laser discharges are inherently unstable, having instability-growth times on the order of 0.1 msec. The single most important factor affecting instability growth at a specific power density level was found to be electron-positive ion recombination. Changes in the recombination process as a consequence of positive ion kinetics were found to result in order of magnitude variations in instability growth. Because of the importance of recombination the effects of ion clustering reactions and water-ion chemistry are discussed in detail.

33543 (AD—886909) **Experimental investigation of a helium-air-methane laser. Technical report Sep 70—Mar 71.** Boney, W.E. III; Barry, J.D. (Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)). Jun 1971. 30p. (AFAL-TR—71-87). NTIS PC A03/MF A01.

A He-Air-CH4-(CO) laser operated both in the Q-switched and cw mode, yielded 78 laser emission lines in the region from 4.8036 to 5.8532 m. These lines all resulted from P(J) sub v, v prime vibrational-rotational transitions in CO from v=2:1 to v=16:15, with J=10 to 15 nominally. Eighteen laser emission lines below 5.0 H were measured. Multiline pulse powers greater than 2 kw were normal. The lasing molecules are formed by electrochemical reactions in the gas mixture.

33544 (COO—2920-4) **Investigation of induced unimolecular decomposition for development of visible chemical lasers. Final report, 1 May 1976—30 April 1977.** Piper, L.G.; Taylor, R.L. (Physical Sciences, Inc., Woburn, Mass. (USA)). May 1977. Contract EY-76-C-02-2920. 68p. (PSI-TR—96). Dep. NTIS, PC A04/MF A01.

This report summarizes the results of a study of azide decomposition for possible application in a visible chemical laser. Task 1 of the subject contract involved thorough review of the chemical literature pertaining to azide decomposition. Covalently bonded azides decompose directly into an electronically excited nitrene (RN) and ground-state molecular nitrogen. Ionic azides decompose to metal atoms and azide radicals. The azide radicals subsequently recombine to form electronically excited nitrogen molecules. Task 2, the experimental phase of this program, involved the study of azide-radical reactions. A flow reactor was built in which large concentrations (up to 10^{13} molec cm^{-3}) of N_3 could be produced from the thermal decomposition of NaN_3. The kinetics of and chemiluminescent products from several reactions of N_3 have been studied, and a method for obtaining absolute concentrations of N_3 is described. The potential utility of azide decomposition for the production of excited electronic states suitable for a laser device and further areas of research germane to this goal are discussed briefly.

33545 (IAEA—200, pp 157-172) **High power CO_2 laser system for plasma research (Lekko I).** Nakai, S.; Matoba, M.; Fujita, H.; Nishimura, H.; Banjyoya, N.; Daido, H.; Seki, T.; Iba, K.; Yamanaka, C. (Osaka Univ. (Japan)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

High power CO_2 laser system of the output energy 200J in nsec was constructed. Engineering problems concerning with the high power generation were investigated; generation of short pulse, oscillation in double band with multi-line, conditions of efficient pumping, system for high energy extraction, isolation of amplifier stages, uni-guide to protect optical components.

33546 (IAEA—200, pp 141-155) **High power glass laser system "Gekko" for fusion research.** Yamanaka, C.; Yamanaka, T.; Kato, Y.; Sasaki, T.; Yoshida, K.; Mizumoto, Y. (Osaka Univ. (Japan)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

The performances of various glass laser systems are being examined at the Institute of Laser Engineering, Osaka University. Comparisons between various glasses are made including the nonlinear refractive index, stimulated emission cross section and optical quality. The two-beam laser systems "Gekko I" and "Gekko II" are

used in target compression experiments and a four-beam system "Gekko IV" is under construction.

33547 (IPP—1/165) **Dye laser system as starting point of a frequency-variable Lyman-α-source of high brightness.** Langer, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). May 1977. 26p. (In German). Dep. NTIS (US Sales Only), PC A03/MF A01.

The resonance and near-resonant Rayleigh scattering from the ground state of neutral hydrogen is a promising method to measure the local density and temperature of neutrals in fusion plasmas. This assumes the development of a frequency-variable Layman-α-source of high brightness. One can produce this by frequency-sextupling of a dye laser in the near infrared. This paper describes experiments and a theoretical model which led to an optimization of the dye laser system. In this way a dye laser power of 20 MW at 7,296 A with a width of 0.1 A was produced with 150 MW Ruby-pumping. The results of this paper show that powers of 10 MW at the three-fold of the Lsub(α)-wavelength (3,648 A) are possible. The applicability of a vacuum-UV-source for Lsub(α)-resonance scattering experiments can be found only after determination of the conversion efficiency for frequency-tripling.

33548 (UCRL—13823) **Fluorescense line-narrowing studies of Nd: glass laser materials.** Riseberg, L.A.; Brecher, C. (GTE Labs., Inc., Waltham, Mass. (USA)). Feb 1978. Contract W-7405-ENG-48. 37p. Dep. NTIS, PC A03/MF A01.

From a detailed study of Nd^{3+} in five different glassy hosts, it was found that even in the absence of specific spectral detail (as in the case of Eu^{3+}), the excitation-dependent patterns of quantum efficiency and radiative and nonradiative transition rates can be powerful tools in characterizing the glass medium. In the case of the fluorophosphate glass, these measurements led to the first experimental evidence for the existence of chemically distinct coordinating species in a mixed anion glass. In view of the strong interest in the fluorophosphates for use in the Nova program, work on this type of glass should be continued. Particular attention should be given to studies on Eu^{3+}-doped mixed anion glasses, since with appropriate compositional variations it may be possible to observe directly the change from a largely oxide to a largely fluoride environment. Particular effort should also be directed toward a correlation of the results of the Nd^{3+} and Eu^{3+} measurements. The second- and fourth-order crystal field parameters (and the structural model derived from them) obtained from Eu^{3+}-doped glass would be used to calculate the corresponding values for Nd^{3+} in the same glassy medium, and thus (hopefully) give a correlation between the structure of the coordinating species and the energy kinetics associated with it. This is more likely to be successful in the fluoroberyllate than in any of the others, and this material should be given first attention. Finally, on a lower priority, attention should be given to other systems, particularly the pure BeF_2 material, mentioned earlier, and its oxide counterpart, SiO_2. Although these are chemically the simplest of common glasses, their spectroscopy is far more complex than previously believed, and work on these systems may be uniquely informative on the effects of compensating cations.

33549 **Method and apparatus for generating coherent near 14 and near 16 micron radiation.** Krupke, W.F. (to Energy Research and Development Administration). US Patent 4,053,852. 11 Oct 1977. Filed date 10 Jul 1975. 6p.

PAT-APPL-594,822.

A method and apparatus for producing coherent radiation in CO_2 vibrational-rotational transitions at wavelengths near 14 and 16 microns are described. This is accomplished by passing a mixture of N_2 and Ar through a glow discharge producing a high vibrational temperature in the N_2, passing the excited N_2 through a nozzle bank creating a supersonic flow thereof, injecting the CO_2 in the supersonic flow creating a population inversion in the CO_2, and directing the saturating pulse of radiation near 10.6 or 9.6 microns into the excited CO_2 creating a population inversion producing coherent radiation at 14 or 16 microns, respectively.

33550 **Pulsed gas laser.** Anderson, L.W.; Fitzsimmons, W.A. (to Wisconsin Alumni Research Foundation). US Patent 4,077,020. 28 Feb 1978. Filed date 20 May 1975. 6p.

A pulsed gas laser is constituted by Blumlein circuits wherein space metal plates function both as capacitors and transmission lines coupling high frequency oscillations to a gas filled laser tube. The tube itself is formed by spaced metal side walls which function as connections to the electrodes to provide for a high frequency, high voltage discharge in the tube to cause the gas to lase. Also shown is a spark gap switch having structural features permitting a long life.

33551 **Method and apparatus for pulse stacking.** Harney, R.C. (to Energy Research and Development Administration). US Patent 4,053,763. 11 Oct 1977. Filed date 25 May 1976. 10p.

PAT-APPL-689,751.

An active pulse stacking system is described that includes an etalon and an electro-optical modulator apparatus combined with a pulse-forming network capable of forming and summing a sequence of time-delayed optical waveforms arising from, for example, a single laser pulse. The Pockels cell pulse stacker may attain an efficiency of about 2.6% while providing a controllable faster-than-exponential time rise in transmitted pulse intensity.

33552 **Stabilized cavity-dumped Nd:YAG laser.** Kennedy, C.J. US Patent 4,044,316. 23 Aug 1977. Filed date 19 Apr 1976. 5p.

In cavity dumped lasers, the relaxation oscillations caused by cavity dumping are stabilized and damped out by placing a nonlinear second-harmonic generation crystal inside the optical cavity of the laser and phase matching it to produce a doubled frequency component of approximately 0.1% that of the circulating power. The degree of damping depends on the conversion percentage, which may be varied by temperature controlling the frequency doubling crystal. A conventional antireflection coating is placed on the crystal to minimize losses.

33553 **Laser and their applications.** Fill, E. (Max-Planck-Gesellschaft zur Foerderung der Wissenschaften e.V., Garching/Muenchen (Germany, F.R.). Projektgruppe fuer Laserforschung). *CZ-Chem.-Tech.;* 6: No. 6, 217-221(Jun 1977). (In German).

17 years after its invention, lasers have found a large number of applications in science and practice. The article compares the main types of lasers and gives a survey of possible applications.

HEAT TRANSFER AND FLUID FLOW

REFER ALSO TO CITATION(S) 32963, 33568

MATERIALS TESTING

33554 (AD—045362) **Radiography with the fission neutrons from californium-252. Final report.** Antal, J.J.; Becker, R.L. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Jul 1977. 14p. (AMMRC-TR—77-18). NTIS PC A02/MF A01.

Fission neutron radiography, with images formed on thin sheets of cellulose nitrate, has been investigated using neutrons from ^{252}Cf. A polyethylene converter provides recoil protons from neutron elastic scattering by hydrogen, which in turn create damage in the cellulose nitrate. Chemical etching then produces a frosted etch-track image which can be reproduced photographically by either scattered or transmitted light. The most readily available cellulose nitrate sheets were found to contain undesirable internal defects and thus films are recast in thicknesses of several mils. The images are of high resolution, as expected from a computer calculation which considered the direction and ranges of the recoil protons in polyethylene. All materials, including those of low atomic weight, may be radiographed with good penetration. The technique is simple and employs inexpensive materials.

33555 (BDX—613-1770(Rev.)) **Fast neutron gauging feasibility study. Final report.** Heckman, R.V. (Bendix Corp., Kansas City, Mo. (USA)). Mar 1978. Contract EY-76-C-04-0613. 40p. Dep. NTIS, PC A03/MF A01.

A study was conducted to determine the ability of a collimated neutron beam to locate defects in polyurethane foam encapsulated between sintered-iron and stainless-steel jackets. Test results indicate that although a source can be used, an iron-filtered neutron beam provides the greatest sensitivity. Voids having a diameter of 0.2 cm, an effective area of 1 cm^2, and a volume of 0.14 cm^3 were successfully detected.

33556 (COO—3161-42) **Fundamental theory of elastic wave scattering by defects in elastic materials: integral equation methods for application to ultrasonic flaw detection.** Gubernatis, J.E.; Domany, E.; Krumhansl, J.A.; Huberman, M. (Cornell Univ., Ithaca, N.Y. (USA). Materials Science Center). May 1976. Contract EY-76-S-02-3161. 96p. Dep. NTIS, PC A05/MF A01.

The use of ultrasonic methods in nondestructive testing depends on the interpretation of the scattering of sound waves by flaws. The theory of elastic waves and their scattering in nonuniform media is developed in detail from first principles, and in generality. Both integral equation and differential methods are discussed, with emphasis on the former. General methods for defining scattering cross sections are presented, and conservation theorems are noted. The Born Approximation to the integral equation is presented, and computed results for several experimental situations are discussed. Several corrections to papers in the literature are made, and in particular the exact scattering of a transverse wave by a spherical flaw is compared with the Rayleigh (long wave) limit.

33557 (NTIS/PS—77/0908) **Nondestructive testing: x-ray photography and radiography (citations from the NTIS data base). Report for 1964-Sep 77.** Reed, W.E. (National Technical Information Serv-

ice, Springfield, Va. (USA)). Oct 1977. 213p. NTIS PC N01/MF N01.

Federally-sponsored research and foreign reports covering techniques, equipment, and applications are cited. Applications include flaw detection, fatigue determination, inspection of joints, and measurement of mechanical and physical properties. (The updated bibliography contains 208 abstracts, 55 of which are new entries to the previous edition.)

33558 (NTIS/PS—77/0909) **Nondestructive testing: x-ray photography and radiography. volume 1. 1970-July 1976 (citations from the Engineering Index Data Base). Report for 1970-Jul 76.** Reed, W.E. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 215p. NTIS PC N01/MF N01.

The bibliography cites reports from worldwide research covering techniques, equipment, and applications. Applications include flaw detection, fatigue determination, inspection of joints, quality control, and measurement of mechanical and physical properties. (This updated bibliography contains 208 abstracts, none of which are new entries to the previous edition.)

33559 (NTIS/PS—77/0910) **Nondestructive testing: x-ray photography and radiography. Volume 2. August 1976—September 1977 (citations from the Engineering Index Data Base). Report for Aug 76—Sep 77.** Reed, W.E. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 117p. NTIS PC N01/MF N01.

The bibliography cites reports from worldwide research covering techniques, equipment, and applications. Applications include flaw detection, fatigue determination, inspection of joints, quality control, and measurement of mechanical and physical properties. (The updated bibliography contains 110 abstracts, all of which are new entries to the previous edition.)

ELECTRONIC CIRCUITS AND DEVICES

REFER ALSO TO CITATION(S) 33650

33560 (BDX—613-1763) **Fabrication and performance of a laminated nonvolatile nondestructive readout memory core. Final report.** Jordan, H.F. Jr. (Bendix Corp., Kansas City, Mo. (USA)). Mar 1978. Contract EY-76-C-04-0613. 19p. Dep. NTIS, PC A02/MF A01.

A technique has been developed for the fabrication of 5.08 mm diameter cores using 0.025 or 0.013 mm thick magnetic sheet material. The technique uses the photoresist used in the photochemical etching process to serve as the adhesive as well. A test technique for the nondestructive readout characteristics of the cores has also been developed.

33561 (BDX—613-1800(Rev.)) **HMC-to-flatpack attachment.** Zawicki, L.R. (Bendix Corp., Kansas City, Mo. (USA)). Apr 1978. Contract EY-76-C-04-0613. 21p. Dep. NTIS, PC A02/MF A01.

A method has been developed for attaching a completed hybrid microcircuit to a flatpack which can then be hermetically sealed. Ablefilm 517B and Epo-Tek H77 epoxies, in conjunction with an abraded flatpack and applied pressure during cure, were shown to provide HMC-to-flatpack bonds which meet all environmental and processing requirements of hybrid microcircuits in two recent programs.

33562 (BDX—613-1809(Rev.)) **Semiconductor die attachment. Final report.** Zawicki, L.R. (Bendix Corp., Kansas City, Mo. (USA)). Apr 1978. Contract EY-76-C-04-0613. 16p. Dep. NTIS, PC A02/MF A01.

A technique was established for attaching non-beam lead semiconductor devices to metallized ceramic substrates for hybrid microcircuits (HMCs). Conductive and non-conductive epoxies were shown to be capable of high shear strengths after exposure to high temperatures (125 to 200°C) for significant periods of time (48 to 168 h). Chip-on-tab devices attached to the substrate with Ablefilm 517 non-conductive epoxy was the technology chosen.

33563 (NTIS/PS—77/0879) **Ion implantation (a bibliography with abstracts). Report for 1964-Sep 77.** Reimherr, G.W. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 258p. NTIS PC N01/MF N01.

The cited reports discuss research concerning ion implantation, particularly as applied to the microelectronics field. Specific topics include equipment, techniques, semiconductor doping, and radiation effects on material properties. (This updated bibliography contains 253 abstracts, 51 of which are new entries to the previous edition.)

33564 (SAND—77-1911) **Discharge life of Mylar capacitors.** Loescher, D.H. (Sandia Labs., Albuquerque, N.Mex. (USA)). Mar 1978. Contract EY-76-C-04-0789. 37p. Dep. NTIS, PC A03/MF A01.

The time of failure has been determined for Mylar capacitors subjected to repeated charge-discharge cycles. The capacitors tested were unimpregnated Mylar film capacitors similar to those used as the main energy storage element in a variety of Sandia designed fire sets. The effects on life of capacitor design, fabrication, and operation were investigated. It is found that multiple layer designs have as long or longer lives than single layer of Mylar designs. Winding at intermediate to high film tension and processing at 80°C result in greater life than do loose winding or processing at 100°C. Evidence is found against the use of a burn-in to improve reliability, but data supporting the use of a high voltage screen are presented. It was found that life decreases rapidly as the applied voltage, electric field, and reversal ratio increase. It is shown that variation of peak current has little effct on life. Life is also little affected by operation at temperatures up to 74°, which is the highest temperature of capacitor operation in most Sandia designed fire sets.

33565 (UCID—17747) **Marx Bank + magnetron circuit model.** Craig, G.; Pettibone, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Mar 1978. Contract W-7405-ENG-48. 14p. Dep. NTIS, PC A02/MF A01.

Thee exact solution to a circuit previously considered is presented. These results confirm the design parameters for the Marx Bank and provide a check for SCEPTER, the computer code which will be used on more realistic circuits to unravel the actual impedance characteristics of the magnetron.

33566 **Saturating time-delay transformer for overcurrent protection.** Praeg, W.F. (to Energy Research and Development Administration). US Patent 4,054,933. 18 Oct 1977. Filed date 18 Dec 1975. 10p.

PAT-APPL-642,045.

Electrical loads connected to d-c supplies are protected from damage by overcurrent in the case of a load fault by connecting in series with the load a saturating transformer that detects a load fault and limits the fault current to a safe level for a period long enough to correct the fault or else disconnect the power supply.

33567 **Decomposition of near-optimum regulators for systems with slow and fast modes.** Chow, J.H.; Kokotovic, P.V. (Univ. of Illinois, Urbana). pp 219-224 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

For systems with slow and fast subsystems a near-optimum state regulator is composed of two subsystem regulators. Conditions for complete separation of slow and fast regulator designs are formulated. A second order approximation of the optimal performance is achieved without the knowledge of the small singular perturbation parameter.

WASTE PROCESSING PLANTS AND EQUIPMENT

REFER ALSO TO CITATION(S) 32873, 33303

COMBUSTION SYSTEMS

REFER ALSO TO CITATION(S) 32757, 32967, 34059

33568 **Heat pipes for improving the temperature homogenity in furnaces.** Brost, O.; Neuer, G. *Brennst.-Waerme-Kraft;* **29**: No. 11, 444-449(Nov 1977). (In German).

Heat pipes are outstandingly suitable to produce a homogeneous temperature distribution on surface and in hollow spaces. In particular, in the temperature range between 500 and 1,100°C, many advantages can be obtained and maximum temperature differences of less than 1 K, even over large areas, can be maintained without difficulties. The article reports on the functioning, the production, as well as the operational behavior of the test samples. Some possible applications and examples of installations for high temperature furnaces are described.

33569 **Burners for firing oil and gas simultaneously or alternately.** Hellwig, A. (Saacke (H.) K.G., Bremen (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 549-552(Nov 1977). (In German).

A description is given of the series SKV burners designed for firing heating oil, used oil, tar oil, etc., of the SG series of gas burners and of the newly designed SKVG burners for the simultaneous firing of oil and gas. The new design is described and two examples are cited to show its applications.

33570 Modern dual-fuel burners. Jacobsen, H. (Elco Oel- und Gasbrennerwerk G.m.b.H., Ravensburg (Germany, F.R.)). *Gas Waerme Int.;* **26**: No. 11, 558-560(Nov 1977). (In German).

Contracts for interruptible gas supplies make it possible to adapt the gas supply flexibly to specific requirements and to avoid excessive costs during network peaks. To make full use of the possibilities inherent in such contracts, it is necessary to have a burner which can be changed over reliably from one fuel to another without any difficulty. The author describes two types of dual-fuel burners with which a wide range of heat output requirements can be met.

33571 Dual-fuel burner for gaseous and liquid fuels. Schreiber, H. (Kloeckner und Co., Hagen (Germany, F.R.). Abt. Anlagenbau). *Gas Waerme Int.;* **26**: No. 11, 552-558(Nov 1977). (In German).

The design of gas, oil and dual-fuel burners with ratings from 0.29 to 45 MW (approx. 025 to 40 Gcal/h) is described. The prices of these burners are shown as a function of heat-release rate. For assessing the profitability of dual-fuel burners, the potential annual savings attainable with such burners are compared with the higher price of such burners as against straight gas burners. Examples are cited to show how the burners are automatically or semi-automatically changed over from gas to alternative fuels. A device for controlling the oxygen content of flue gas is described which is designed to improve the efficiency of new and existing installations and to reduce the emission of atmospheric pollutants.

33572 Potential reduction in the emission of nitrogen oxides from boiler furnaces and limitations. Kremer, H. (Bochum Univ. (Germany, F.R.). Lehrstuhl fuer Energieanlagentechnik). *Gas Waerme Int.;* **26**: No. 2, 47-54(Feb 1977). (In German).

Combustion processes are unavoidably accompanied by the formation of different pollutants such as nitric oxide (NO) which can be partly or almost fully verified in the combustion products. Further oxidation at lower temperatures (roughly below 500°C) causes the NO to change into nitrogen dioxide (NO_2) which is known to be toxic directly or indirectly via subsequent reactions. Based on numerous investigations carried out in several places the mechanism of NO formation as determined by Zeldovic was shown to be mainly responsible. The formation of nitrogen oxide is mainly attributable to atomic oxygen. This applies predominantly to the 'primary' formation of NO within the reaction zones and particularly to the 'thermal' formation of NO by oxygen atoms from the dissociation of oxygen after completion of the combustion process proper. From this follows that the lowering of the combustion temperature represents the main method for reducing the emission of nitrogen oxides. This can be achieved, for instance, by reducing the oxygen partial pressure. The author deals with theoretical and practical results pertaining to this problem and shows the limitations and disadvantages of the measures considered, also in respect of the formation of other pollutants.

33573 Steam generator. Schaefer, C.D. (to Sonaqua, Inc., Chicago, Ill. (USA)). German(FRG) Patent 2,400588/C/. 9 Dec 1976. 10p. (In German).

The patent is concerned with a steam generator, which converts rotational energy into steam. Friction heat is not used, as in the previously known rotating generators, but the so called 'water hammer effect'. By continuously producing such shock waves, the temperature of the water brought in is raised to produce steam. A rotor in the form of a frustrum of a cone rotates at high speed in a housing of corresponding shape. Between the rotor and the housing there are circumferential gaps for bringing in and heating the water and for steam formation. The rotor contains several channels. Several of the gaps and channel have a radial component, and others are closed at the outer end, so that suitable pressures are produced in the water or steam during rotation. By suitable arrangement and cross-section of the channels and suitable values of centrifugal forces, a continual production of shock waves is achieved. Application to central heating, in the chemical industry, for natural gas and oil production are described as 'very suitable'. Steam at high temperature and pressure can be produced with high efficiency.

UNDERGROUND ENGINEERING

REFER ALSO TO CITATION(S) 32652, 32667, 32710

POLLUTION CONTROL EQUIPMENT

REFER ALSO TO CITATION(S) 33390

33574 (PB—272770) Dual alkali test and evaluation program. Volume II. laboratory and pilot plant programs. Final report May 73—Apr 77. LaMantia, C.R.; Lunt, R.R.; Oberholtzer, J.E.; Field, E.L.; Valentine, J.R. (Little (Arthur D.), Inc., Cambridge, Mass. (USA)). May 1977. Contract EPA-68-02-1071. 342p. NTIS PC A15/MF A01.

Volume II of the report covers Tasks I and II of a three-task program to investigate, characterize, and evaluate the basic process chemistry and the various operating modes of sodium-based dual alkali scrubbing processes. The tasks were: (1) laboratory studies at both Arthur D. Little, Inc. (ADL) and IERL-RTP; (2) pilot plant operations in a 1200 scfm system at ADL; and (3) a prototype test program on a 20 MW dual alkali system at Plant Scholz. Dual alkali system operating modes on high and low sulfur fuel applications investigated included: concentrated and dilute dual alkali systems, lime and limestone regeneration, and slipstream sulfate treatment schemes. For each mode, the dual alkali process was characterized in terms of SO_2 removal, chemical consumption, oxidation, sulfate precipitation and control, waste solids characteristics, and soluble solids losses.

33575 SO/sub x/ scrubbing: clearing the air. *Environ. Sci. Technol.;* **12**: No. 1, 16-18(Jan 1978).

At the Fourth Symposium on Flue Gas Desulfurization (FGD) numerous technologies were discussed. In the article a variety of scrubbers are mentioned, some of which generate the SO/sub x/ reactant and some which generate marketable byproducts, such as gypsum. Among the processes described is a concentrated-mode lime- regeneration sodium/calcium dual alkali process, where SO/sub x/ is removed by sodium contact, and hydrated lime regenerates the sodium. Ore iron(111)-catalyzed process with limestone leads to the formation of high-grade gypsum. Other developments involve scrubbers with other than lime or limestone, for example a system using regenerable MgO, that is 93% efficient in SO_2 removal and produces marketable 98% sulfuric acid. It is stated that future emphasis will probably be on more marketable by-products, regenerable reactants, as well as air cleanup.

33576 Nonferrous smelter studies: theoretical investigation of role of multihearth roaster operations in copper smelter gas blending schemes for control of SO_2. Carpenter, B.H. (Research Triange Inst., Research Triangle Park, NC). *Environ. Sci. Technol.;* **12**: No. 1, 57-62(Jan 1978).

A possible technology for meeting the Environmental Protection Agency's (EPA) proposed New Source Performance Standards for copper smelting is to blend lean SO_2 gas streams from reverberatory furnaces with stronger gases to obtain a SO_2 concentration sufficient to produce sulfuric acid without use of supplementary fuel. In such an approach, a high concentration of SO_2 in the roaster gases is necessary to counterbalance low concentrations in the reverberatory furnace gases. An analysis is made of the calcining of copper concentrates in multihearth roasters. The oxygen concentration of the exit gas is identified as the primary process control variable for maintaining a high level of SO_2 in the exit gas stream. The SO_2 concentrations in the exit gas that can be attained by controlling the exit gas oxygen concentration at 12 vol%, a value that has been achieved in practice, are estimated for removal of from 0.1 to 0.65 of the charged sulfur, to cover the extent of roasting that might be elected. The effect of arsenic as an impurity in the concentrate on the attainable SO_2 concentration is also shown. The results indicate that with proper control of the oxygen level therein, exit gases from U.S. multihearth roasters could be held at an SO_2 concentration of 5 vol%, dry basis, or higher.

33577 Nonferrous smelter studies: investigation of importance of 12 operating factors on SO_2 concentration of exit gases from multihearth roasting of copper concentrates. Carpenter, B.H. (Research Triangle Inst., Research Triangle Park, NC); Hartwell, T.; Smith, K.J.C. (Research Triange Inst., Research Triangle Park, NC). *Environ. Sci. Technol.;* **12**: No. 1, 62-66(Jan 1978).

Multihearth roaster exit gases must be kept at 5% or more SO_2 if gases from all three smelting processes—roasting, smelting, and converting—are to be processed autogenously in a sulfuric acid plant. This study of the practical effects of multihearth roaster operating parameters confirms the findings of a previous theoretical study concerning the importance of control of exit gas oyxgen concentration to maintaining the desired SO_2 level, and further clarifies the concept of a new mode of multihearth furnace operation that provides the desired copper calcine while maintaining the necessary SO_2 concentration of the exit gases. Twelve practical operating factors that could affect the exit gas SO_2 concentration are examined by ridge regression analysis of data from 128 tests of a multihearth roaster system. One of these factors, the precent oxygen in the exit gases, accounts for 84% of the variance in their SO_2 content. Several of the tests attain SO_2 levels of 5—7% whenever the exit gas oxygen level is limited to 12% or less.

33578 Wet scrubbing of fly ash and SO_2. *Environ. Sci. Technol.;* **11**: No. 12, 1054-1055(Nov 1977).

The scrubber on the Sherco plant of Northern States Power Company at Becker, Minn.--45 miles NW of Minneapolis-St. Paul--has been operating for more than one and a half years. The Sherco station of the NSP in Sherburne County has two 700-MW coal-fired

units. Unit 1 started commercial operation May 1976 and Unit 2 in May 1977. The units fire about 400 tons of coal each hour and use about 3 tons of limestone per hour in the scrubbing operation. The coal contains about 9% ash and 0.8% sulfur. Stack gas exit conditions on units 1 and 2 are 0.04 grains/dscf of particulate matter and 350 ppM SO_2. The scrubbers remove in excess of 50% of the SO_2 and 99% of the particulate matter to achieve this condition. Units 1 and 2 have C-E boilers, GE turbines, and C-E scrubbers. These units represent a $368 million plant investment; the air pollution controls, including the C-E scrubbers, cost 55 million. Two additional units 3 and 4, are planned for 1981 and 1983, respectively. These units will have B and W (Babcock and Wilcox) boilers, Westinghouse turbines, and C-E scrubbers. The newer scrubbers will get the particulate loading down to an equivalent stack gas exit condition of 0.02 grains/dscf.

33579 Studies on the variations of electrical resistivity of fly ash due to sorption of gases and vapors: possible ways to improve the dust-removal rate of electric filters. Pt. 2. Influence of steam sorption on changes in the electrical resistance of some flight ash components. Petkovic, D.; Koncar-Djurdjevic, S. *Staub-Reinhalt. Luft;* 37: No. 8, 291-296(Aug 1977). (In German).

Electrical resistivity of the pure powders as, $FeSO_4$, Na_2SO_4, Na_2SO_3, glas beads, K_2SO_4, Fe_2O_3, $Ca(OH)_2$, $MgSO_4$, CaO, SiO_2, in the new flow-type cell, due to the temperature and gas humidity was determined. It is found that the electrical resistivity in a dry gas on the 140°C, rises according with cited order. Electrical resistivity of the silica and Na_2SO_4 mixtures of different weight ratios, gas temperatures and moisture contents were measured. A rather complicated relationship was found. Some observations quoted in the literature have been discussed.

33580 Hybrid-type electrostatic precipitator. Masuda, S. (Univ. of Tokyo, Japan); Ago, S.; Itoh, T.; Saito, H.; Furuya, N. *J. Air Pollut. Control Assoc.;* 27: No. 3, 241-242(Mar 1977).

The hybrid-type electrostatic precipitator has been developed and in successful operation for 4 years at several plants in Japan, including a cement Lepol kiln. A major portion of dust, about 80 to 90 percent in weight, is collected in the dry stage located at the upstream side. The remainder is effectively removed in the wet stage. The slurry generated is fed to a thickener, in which water is separated from the dense slurry and recycled for reuse as irrigation water. The dense slurry, small in amount, can either be dried in a suitable drier using the apparent heat of the inlet gas, or be used for material processing such as dust pelletizing. The advantages of the hybrid-type electrostatic precipitator are the reduction in size and cost, the dust recovery in a dry condition, the reduction in irrigation water and slurry, and the effective removal in the wet stage of gaseous pollutants of flue gas, such as sulfur oxides, HF and HCl.

POWER CYCLES

BRAYTON

33581 Motor turbine. Baentsch, E. German(FRG) Patent 2,536,739/A/. 3 Mar 1977. 9p. (In German).

A motor turbine is described which combines the advantages of gas turbines and internal combustion engines while avoiding the shortcomings of both aggregates. In the motor turbine, preparation for combustion takes place; conversion into power takes place in a normal motor cylinder with conventional combustion space and cylinder, both elements rotating continuously together. The power losses of motors with oscillating pistons are thus avoided. The system is particularly suitable for two-stroke operation. Detailed descriptions of the motor construction are given.

RANKINE

REFER ALSO TO CITATION(S) 33175, 33308, 33357

STIRLING

REFER ALSO TO CITATION(S) 33175

OTHER

33582 Converter for kinetic energy. Wendner, W. German(FRG) Patent 2,535,898/A/. 3 Mar 1977. 7p. (In German).

The invention concerns the conversion of rotary movement into to-and-fro movement of a piston and vice versa, i.e. the function of a crank drive. According to the invention, the crank movement of the Pleuel rod is to be replaced by a straight line to-and-fro movement. For this purpose the crank drive is replaced by a planetary (epicyclic) gearing. The sun wheel turns around an eccentric axis. The crank rod is provided with a slit, through which the axis passes, so that the crank rod can move to-and-fro at right angles to the axis. Planet wheels are fixed on the crank rod on both sides of the sun wheel, on the side towards the piston and on the side away from the piston. Thus the eccentric rotation of the sun wheel around its axis produces a straight line to-and-fro movement of the piston. So that, conversely, a to-and-fro movement of the piston and the Pleuel rod shall produce rotation of the sun wheel, it should have a heart shaped, more or less irregular circumference, whose exact calculation the inventor will leave to research institutes.

PARTICLE ACCELERATORS

DESIGN, DEVELOPMENT, AND OPERATION

33583 (ORNL/TM—6138) **Preliminary report on the promise of accelerator-driven natural-uranium-fueled light-water-moderated breeding power reactors.** Greenspan, E. (Oak Ridge National Lab., Tenn. (USA)). Jul 1977. Contract W-7405-ENG-26. 72p. Dep. NTIS, PC A04/MF A01.

A new concept for a power breeder reactor that consists of an accelerator-driven subcritical thermal fission system is proposed. In this system an accelerator provides a high-energy proton beam which interacts with a heavy-element target to produce, via spallation reactions, an intense source of neutrons. This source then drives a natural-uranium-fueled, light-water-moderated and -cooled subcritical blanket which both breeds new fuel and generates heat that can be converted to electrical power. The report given presents a general layout of the resulting Accelerator Driven Light Water Reactor (ADLWR), evaluates its performance, discusses its fuel cycle characteristics, and identifies the potential contributions to the nuclear energy economy this type of power reactor might make. A light-water thermal fission system is found to provide an attractive feature when designed to be source-driven. The equilibrium fissile fuel content that gives the highest energy multiplication is approximately equal to the content of ^{235}U in natural uranium. Consequently, natural-uranium-fueled ADLWRs that are designed to have the highest energy generation per source neutron are also fuel-self-sufficient; that is, their fissile fuel content remains constant with burnup. This feature allows the development of a nuclear energy system that is based on the most highly developed fission technology available (the light water reactor technology) and yet has a simple and safe fuel cycle. ADLWRs will breed on natural uranium, have no doubling time limitation, and be free from the need for uranium enrichment or for the separation of plutonium. It appears that ADLWRs could also be efficiently operated with thorium fuel cycles and with denatured fuel cycles.

33584 (UCRL-Trans—11336) **"Angara-5" accelerator system.** Velikhov, E.P.; Glukhikh, V.A.; Gusev, O.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). Feb 1978. Translation of NIIEFA-D—0301, 1976. 40p. Dep. NTIS, PC A03/MF A01.

Portions of document are illegible.

Some considerations are given with respect to the accelerating system "Angara-5," which has a beam power of 10^{14}W. The system is intended for the experiments of pulse initiation of the controlled fusion reaction by the high-current electron beams and operation in the thermonuclear station conditions. Beam transport, primary energy sources, accelerator requirements, module parameters, and the explosion chamber are discussed.

BEAM DYNAMICS, FIELD CALCULATIONS, AND ION OPTICS

33585 (BNL—24026) **Saturation of space charge driven instabilities in beam transport systems.** Haber, I.; Maschke, A.W. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 2p. (CONF-771073—10). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

A brief discussion is given of instabilities in the presence of space charge which can limit the power transported in a focused channel. Plots of the four-dimensional phase space are given. (PMA)

33586 (BNL—24027) **Low beta linacs.** Kustom, R.; Moretti, A.; Staples, J.; Khoe, T.K.; Keane, J. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 7p. (CONF-771073—9). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

Portions of document are illegible.

A summary is given of discussions on the use of low-β linacs in a system for heavy ion fusion. Topics considered include: space charge limit; low-β linac structures; independently phased cavities;

the Brookhaven low-β program; and rf deflectors for combining two linac beams. (PMA)

33587 (BNL—24028) **HIDE working groups. A. Synchrotron based system.** Barton, M.Q. (Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 2p. (CONF-771073—14). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

Portions of document are illegible.

A summary is given of a week's discussions on an ion source to target scenario for a synchrotron for heavy ion fusion. Topics considered include: the number of beams on the target; beam dynamics; and a number of areas explicitly identified as needing further work. (PMA)

33588 (COO—3496-65) **Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.** Huizenga, J.R. (Rochester Univ., N.Y. (USA). Dept. of Chemistry and Physics). Aug 1977. Contract EY-76-S-02-3496. 189p. Dep. NTIS, PC A09/MF A01.

Separate abstracts were prepared for the 12 papers. (JFP)

33589 (LBL—7221) **Beam bunching in a final storage ring.** Lambertson, G.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 18 Nov 1977. Contract W-7405-ENG-48. 7p. (CONF-771073—3). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

A calculation is presented for the final bunching of a particle beam in a synchrotron or storage ring. The voltage per turn, the harmonic number, and the bunching time are obtained. (PMA)

33590 (LBL—7222) **"Figure of merit" Q/μ/sub max//sup 2/3/, for beam transport through periodic focussing systems.** Laslett, L.J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 23 Nov 1977. Contract W-7405-ENG-48. 9p. (CONF-771073—5). Dep. NTIS, PC A02/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

A discussion is given of a figure of merit indicative of the stability of high intensity beam transport systems. A table is provided giving this quantity under various conditions, and the limits for solenoidal focusing systems are obtained. (PMA)

33591 (LBL—7245) **Estimates of post-acceleration longitudinal bunch compression.** Judd, D.L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 25 Nov 1977. Contract W-7405-ENG-48. 28p. (CONF-771073—4). Dep. NTIS, PC A03/MF A01.

From Heavy ion fusion workshop; Upton, NY, USA (17 Oct 1977).

A simple analytic method is developed, based on physical approximations, for treating transient implosive longitudinal compression of bunches of heavy ions in an accelerator system for ignition of inertial-confinement fusion pellet targets. Parametric dependences of attainable compressions and of beam path lengths and times during compression are indicated for ramped pulsed-gap lines, rf systems in storage and accumulator rings, and composite systems, including sections of free drift. It appears that for high-confidence pellets in a plant producing 1000 MW of electric power the needed pulse lengths cannot be obtained with rings alone unless an unreasonably large number of them are used, independent of choice of rf harmonic number. In contrast, pulsed-gap lines alone can meet this need. The effects of an initial inward compressive drift and of longitudinal emittance are included.

33592 (NVO/0655—103) **Western gas sands project status report.** (Energy Research and Development Administration, Bartlesville, Okla. (USA). Bartlesville Energy Research Center). 1 Jan 1978. Contract EY-76-C-08-0655. 47p. Dep. NTIS, PC A03/MF A01.

The Western Gas Sands Project Implementation Plan, Project Plan Document FY 78, and the Quarterly Basin Activities report are in various stages of preparation. Resource assessment by the USGS is continuing. Some base maps are completed and others are being prepared. Core from the Book Cliffs area has been made available to USGS for study and core sampling from the northern Green River Basin is continuing with fourteen additional samples submitted for paleoanalysis. Research and Development by Energy Research Centers and National Laboratories funded by the Department of Energy (DOE) is continuing. These activities are directed toward the development of new tools and instrumentation systems, rock mechanics, mathematical modeling and data analysis. The field tests and demonstrations being carried out in the Uinta and Piceance Basins are: Gas Producing Enterprises (GPE)—Natural Buttes No. 14, 18, 19, 20, 21, and 22; Mobil Research and Development—F-31-13G; and Rio Blanco Natural Gas—498-4-1. Colorado Interstate Gas (CIG) is preparing to commence field activities in January 1978 in the Wattenberg Field of northeastern Colorado.

33593 (SAND—78-6005) **REB focusing in a high-voltage diode.** Afonin, I.P.; Babykin, M.V.; Baev, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Feb 1978. Translation by P. Newman of Issledovanie fokusirovki REP v vysokovol'tnom diode. 25p. Dep. NTIS, PC A02/MF A01.

Experimental data on the focusing of an intense relativistic electron beam on the "Angara-1" and "Kalmar-1" accelerators are reported. The use of these accelerators to simulate conditions in a controlled thermonuclear reactor with inertial plasma confinement is discussed.

AUXILIARIES AND COMPONENTS

33594 (COO/2545—1) **Fabrication of a 180° electron scattering facility. Final report, January 2, 1975—January 1, 1978.** Peterson, G.A. (Massachusetts Univ., Amherst (USA)). Jan 1978. Contract EY-76-C-02-2545. 118p. Dep. NTIS, PC A06/MF A01.

A system of four dipole magnets to be used for 180° electron scattering studies at the 400 MeV William F. Bates Electron Linear Accelerator of Middleton, Massachusetts was constructed and tested. The first three magnets through which the incident beam passes have similar pole shapes and serve only as beam transport elements. The fourth magnet directs the incident beam onto a target, and also receives and deflects the backscattered electrons into a large magnetic spectrometer operating in an energy-loss mode. The system may be used for both elastic and inelastic electron scattering without moving the spectrometer. The incident beam and the post-target beam travel along the same line. Tests show that a constant solid angle is maintained for scattering regardless of the energy loss suffered by the electron in the target. A resolution inherent to the system of less than 2.5×10^{-4} was found.

STORAGE RINGS

REFER ALSO TO CITATION(S) 33589, 33591

33595 (CONF-770753—) **Proceedings of the 1977 Isabelle Summer Workshop.** (Brookhaven National Lab., Upton, N.Y. (USA)). 18 Jul 1977. Contract EY-76-C-02-0016. 433p. (BNL—50721). Dep. NTIS, PC A19/MF A01.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977).

A report is given of the activities of the 1977 ISABELLE Summer Workshop, held from July 18 to 29, 1977 at the Brookhaven National Laboratory. An abstract was prepared for each of the seventy-four separate presentations for inclusion in DOE Energy Research Abstracts (ERA). (PMA)

33596 (CONF-770753—, pp 1-16) **Summary of activity.** Marx, J. (Lawrence Berkeley Lab., CA); Ozaki, S. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

An overview is given of the work accomplished at the 1977 ISABELLE Summer Workshop. Topics discussed include: hodoscopes; drift chambers and PWC's; Cerenkov counters; neutral detectors and calorimeters; data handling; exotic detectors; special experimental configurations; and theoretical considerations. (PMA)

33597 (CONF-770753—, pp 20-39) **Microchannel plate photodetectors.** Majka, R. (Yale Univ., New Haven). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A review is given the status of development work on photodetectors using microchannel plates (MCP) as the electron gain element. Projections are made and opinions are presented on what might be available in the next few years. Several uses for these devices at ISABELLE are mentioned.

33598 (CONF-770753—, pp 39-40) **Report of the subgroup on drift and proportional chambers.** Etkin, A.; Kostoulas, I.; Kramer, M.A.; Platner, E.D.; Skubic, P.; Thaler, J.; Thun, R.; Walenta, A.; Williams, H.H.; Witherell, M.; Yamada, R. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The PWC and drift chamber subgroup concluded that a narrow anode spacing drift chamber with cathode strip readout at fairly large angle stereo is an optimum choice of detector to provide 5 to 10 nsec time resolution, 100 μ position resolution and three projection stereo of the same point in space for efficient track reconstruction. Integrated circuitry under development will allow rates of 10^6 hits per sec-wire with less than 5% deadtime loss. With current technology, drift-PWC deterioration will occur at approximately 2 10^{11} hits per cm^2 which at a luminosity of 10^{32} will give a detector lifetime of 70 days at 2 cm from the beam axis.

33599 (CONF-770753—, pp 40-41) **Rate estimates at ISABELLE.** Etkin, A. (Brookhaven National Lab., Upton, NY). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The single rates to expect in detectors at ISABELLE are estimated, and the particle density per event is given. (PMA)

33600 (CONF-770753—, pp 58-60) **Three-dimensional points from PWC's and drift chambers.** Kramer, M.A. (City Coll. of New York). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Two aspects of the high event rates anticipated at ISABELLE are, first, the need for sophisticated triggers to select interesting events and, second, the enormous data reduction capabilities that will be required. It was concluded that both of these problems must be considered in the design of the detectors. A description is given of some of the advantages that a PWC or drift chamber system that provides correlated x-y readouts would provide, and a scheme for implementing such a detector with adequate spatial and rate capabilities is discussed.

33601 (CONF-770753—, pp 60-66) **Drift chamber performance in the field of a superconducting magnet: measurement of the drift angle.** Sanders, G.H.; Sherman, S.; McDonald, K.T.; Smith, A.J.S.; Thaler, J.J. (Princeton Univ., NJ). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Results are presented of the first measurements in a study of drift chamber performance in magnetic fields up to 6 tesla. The angle of the electron drift was measured as a function of electric and magnetic field intensity. It appears that even at the high fields of superconducting magnets (3 to 6 tesla) the drift angle induced by the Lorentz force can be corrected for with tilted electric drift fields and/or the use of Xenon gas. At 3 tesla a drift field tilted at 45° with a magnitude of 3.5 kV/cm should restore normal operating conditions. At 4 tesla, a 45° tilt field would have a magnitude 5 kV/cm.

33602 (CONF-770753—, pp 66-71) **Plastic flashtube chambers.** Frisken, W.R. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief discussion is given of the use and operation of plastic flashtube chambers. Gas leaks, electric pulsing, the glow discharge, and readout methods are considered. Three distinct problems with high rate applications deal with resolving time, dead time, and polarization/neutralization of the chamber. (PMA)

33603 (CONF-770753—, pp 72-77) **Charged particle identification: Cherenkov counters at ISABELLE.** Etkin, A. (Brookhaven National Lab., Upton, NY); Kostoulas, I.; Leith, D.W.G.S.; Thun, R. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief summary is given of a study of Cherenkov counters for ISABELLE. The study was certainy not exhaustive and was meant primarily to suggest future detector development. A substantial research effort is needed in order to insure that Cherenkov counters utilizing photoionization are fully exploited.

33604 (CONF-770753—, pp 81-90) **Projection chambers and dE/dx at ISABELLE.** Alspector, J. (Brookhaven National Lab., Upton, NY); Ozaki, S.; Walenta, A.H.; White, D.H.; Benary, O.; Rosenson, L.; Roe, B.; Ditzler, W.R.; Watts, T.; Horwitz, N. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The luminosity of 2 x 10^{32} was taken as a goal for a device that measures charged particle momenta over a wide solid angle. It appears that a projection chamber is capable of operation in this mode, providing care is taken to optimize the geometry with this high flux in mind. Some calculations indicated that optimism is required, but in no direction have the demands on the apparatus appeared to be well beyond those attainable. In addition dE/dx measurements yielding particle identification over the median momentum range, about 2 to 30 GeV/c, are also feasible.

33605 (CONF-770753—, pp 96-104) **Neutral particle detection and calorimeters: summary report of neutral detector subgroup.** Akerlof, C.; Bensinger, J.; Donaldson, G. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Experimental factors which must be considered in the design of calorimeters for specific experiments at ISABELLE are discussed. These factors include rate, energy resolution, servicing, segmentation, calibration, readout electronics, and use of calorimeters for electromagnetic showers. A discussion is given of some advantages and disadvantages of liquid Argon sampling calorimeters, including some of the experience gained in running at the CERN Intersecting Storage Rings.

33606 (CONF-770753—, pp 104-113) **Utility of a high P/sub T/ trigger for a large hadron calorimeter.** Akerlof, C. (Univ. of Michigan, Ann Arbor); Edelstein, R.M.; Pless, I.; Rosenson, L. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A unique fast, electronic trigger, which is sensitive only to p/sub perpendicular to/ was investigated and it is a useful tool for the assumed configuration. This electronic trigger is the basis for the physics triggers used for the study of single particle p/sub perpendicular/ behavior, "Jet" p/sub perpendicular/ behavior, and missing p/sub perpendicular/ phenomenon. A suitable p/sub perpendicular/ trigger for single particles consists of requiring a minimum p/sub perpendicular/ pulse in one or two adjacent phi sectors. A jet trigger could consist of requiring a p/sub perpendicular/ pulse in the whole detector that is twice the minimum single jet p/sub perpendicular/ which is wished to use as a minimum cut-off. A missing p/sub perpendicular/ trigger seems quite straightforward and could be useful for the study of new phenomenon.

33607 (CONF-770753—, pp 114-115) **Data handling: data handling subgroup summary.** Akerlof, C.; Connolly, P.; Cutts, D. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The data handling subgroup addressed the problem of data acquisition systems at ISABELLE from detector data outputs through to off-line computation. The discussions pertaining to triggering, preprocessing of data, and the on-line and off-line computing needs are briefly described.

33608 (CONF-770753—, pp 115-123) **Computer facilities for ISABELLE data handling.** Kramer, M.A. (City Coll. of New York); Love, W.A.; Miller, R.J.; Zeller, M. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The analysis of data produced by ISABELLE experiments will need a large system of computers. An official group of prospective users and operators of that system should begin planning now. Included in the array will be a substantial computer system at each ISABELLE intersection in use. These systems must include enough computer power to keep experimenters aware of the health of the experiment. This will require at least one very fast sophisticated processor in the system, the size depending on the experiment. Other features of the intersection systems must be a good, high speed graphic display, ability to record data on magnetic tape at 500 to 1000 KB, and a high speed link to a central computer. The operating system software must support multiple interactive users. A substantially larger capacity computer system, shared by the six intersection region experiments, must be available with good turnaround for experimenters while ISABELLE is running. A computer support group will be required to maintain the computer system and to provide and maintain software common to all experiments. Special superfast computing hardware or special function processors constructed with microprocessor circuitry may be necessary both in the data gathering and data processing work. Thus both the local and central processors should be chosen with the possibility of interfacing such devices in mind.

33609 (CONF-770753—, pp 123-126) **Considerations concerning a multiplicity trigger.** Akerlof, C. (Univ. of Michigan, Ann Arbor); Roe, B.; Gibbard, B. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

In order to explore the kind of data acquisition systems that might be required for ISABELLE, the magnetic dipole forward detectors described in the 1976 ISABELLE Summer Study were examined. In particular, the possibility of triggering such a spectrometer according to the multiplicity of charged particles detected by the associated proportional drift chambers was considered. It is estimated that, within 10μsec, a parallel array of dedicated micrporocessors can form a multiplicity estimate so that a trigger rejection ratio of 1000 : 1 may be realized. This would be particularly useful for low multiplicity, low cross section reactions such as elastic scattering and double Pomeron exchange.

33610 (CONF-770753—, pp 127-128) **P/sub T/ pretrigger for FATS.** Ditzler, W.R. (Purdue Univ., Lafayette, IN). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Any data-taking system for the FATS/WASP spectrometer system must deal with a severe rate problem. A conventional scintillator hodoscope is considered for use as a pretrigger to reduce the trigger rate by a factor of ten.

33611 (CONF-770753—, pp 128-134) **Large P/sub T/ trigger for ISABELLE.** Zeller, M.E. (Yale Univ., New Haven). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

As an exercise to determine the feasibility of operating the Large Aperature Spectrometer at high luminosities, a trigger system was developed to select events which have high P/sub T/ at modest angles with respect to the colliding beams. The trigger employs the readout of segmented cathode chambers and an extension of the RAM method of matrix logic. It is realized that a large P/sub T/ trigger on forward going particles by means of fast tract reconstruction may not be the most expeditious approach. Thus, the system described should be taken more as a demonstration of the ability to work in the high particle fluxes proposed at ISABELLE than as a proposal for the ultimate trigger.

33612 (CONF-770753—, pp 134-140) **Data handling for the "big lepton" detector.** Cutts, D. (Brown Univ., Providence). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The large lepton detector proposed and described in previous workshops was used as a known standard to study how data might be gathered, sorted, and recorded for ISABELLE detectors. The main source of concern is the high singles rate throughout most of the detector, together with the enormous number of individual devices that are running at this rate and must be serviced for each event. A calculation is given of this rate; the result is 1.0×10^7 particles/sec into the detector (at 10^{33}/cm^2 sec). In this particular situation the use of charge coupled devices is natural; individual data elements feed continuously into these "analog delay lines"; yet the data relevant to an occasional event are processed in parallel through a limited number of channels. The general technique seems desirable for many large scale experiments which manage to achieve in some way a reasonable trigger rate.

33613 (CONF-770753—, pp 140-145) **CCD's at TPC.** Zeller, M.E. (Yale Univ., New Haven). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The CCD, Charge Coupled Device, is an analog shift register for which application to the readout of particle detectors has recently been realized. These devices can be used to detect optical information directly, providing an automated readout for streamer or other optical chambers, or as a single input shift register, acting in this instance as a delay line for analog information. A description is given of the latter mode of operation and its utility as a readout method for drift chambers. Most of the information contained herein has been obtained from tests performed in connection with PEP TPC project, PEP-4. That detector will employ approximately 10^4 CCD's making it a reasonable testing ground for ISABELLE size detectors.

33614 (CONF-770753—, pp 146-154) **Feasibility of detecting the macroscopic electromagnetic field of a relativistic particle.** Sandweiss, J. (Yale Univ., New Haven). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The core techniques of experimental high-energy physics deal with measurements of the positions, energies, and types of fast moving elementary particles. With the continuing development of high energy accelerators and the sharpening focus of attention on processes occurring at ever smaller distances (and hence of ever smaller cross sections) these techniques face formidable challenges. New techniques, even those which may require substantial research and development, could turn out to offer significant advantages. It is with this "philosophy" that work given was undertaken. The analysis shows, however, that such efforts would not lead to a useful detector.

33615 (CONF-770753—, pp 156-159) **Can we do non-coincidence experiments at ISABELLE.** Roe, B. (Univ. of Michigan, Ann Arbor). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

With the very high luminosity proposed for ISABELLE, the forward flux of particles is very large. It is unfortunate to have to reduce luminosity needed by others to look at high data rate experiments. The possibility of using Cherenkov counters without coincidences is examined. The method described is not a simple one and background may be formidable.

33616 (CONF-770753—, pp 160-179) **Lepton detector facility for ISABELLE.** McDonald, K.T.; Thaler, J.J. (Princeton Univ., NJ). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A lepton detector facility based around a 4T superconducting solenoid magnet is proposed. The large field permits accurate momentum measurements in a small volume, and also suppresses high particle fluxes by trapping low momentum particles near the beam. For muon detection, hadron filters are added at the axis of and outside the magnet. A resolution of 1.5% at 50 GeV/c momentum can be attained. With the addition of calorimeter modules the detector would be a powerful tool for the study of hadron jets.

33617 (CONF-770753—, pp 190-193) **An exercise in gigantism: muon polarization measurements at ISABELLE.** Kasha, H. (Yale Univ., New Haven). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The possibility of carrying out muon polarization measurements at ISABELLE is briefly examined. The reasons for doing such measurements may well range from checking the obvious to exploring the unexpected. A measurement of the longitudinal muon polarization can serve as a check of the W^+ decay sample, or may serve as a tool to shed additional light on a new state or process. It is concluded that muon polarization measurements at ISABELLE are on the threshold of possibility, especially if one has to decide between widely separated values.

33618 (CONF-770753—, pp 209-220) **Gluon interactions, or, hadron physics at ISABELLE.** Kane, G.L. (Univ. of Michigan, Ann Arbor). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

It is felt that new particle physics can be learned at ISABELLE from all the conventional hadronic measurements (and not just from the tiny part of the cross section due to large P/sub T/ jets and lepton spectra). It may be that much of the experimental (assuming theorists need help) stimulation of the development of Quantum Chromodynamics (QCD) will be due to ISABELLE. The basic point is that the thing which is really new in QCD is the gluons and their interactions. Some typical hadronic measurements are listed, and how they might be fruitfully interpreted in terms of "new physics" is discussed.

33619 (CONF-770753—, pp 228-235) **Further comments on W physics at ISABELLE energies.** Wang, L.L. (Brookhaven National Lab., Upton, NY). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief discussion is given of the history of weak interactions and the W boson. It is hoped that ISABELLE will provide a very fruitful ground for searching for intermediate bosons and studying the properties of weak interactions.

33620 (CONF-770753—, pp 257-262) **Interaction regions and experimental needs: summary of activity.** Ferbel, T. (Univ. of Rochester, NY); Littenberg, L. 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief review is given of the topics discussed with respect to experimental facilities at ISABELLE. These topics include: (1) running at ISABELLE; (2) ISABELLE operating modes; (3) mobility and powering of large detectors; (4) review of experiments; (5) experimental halls; (6) radiation safety and shielding; and (7) data transfer and acquisition. (PMA)

33621 (CONF-770753—, pp 270-275) **Small experiment at ISABELLE.** Ogren, H. (Indiana Univ., Bloomington). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Two small experiments, one at ISR and one at Fermilab, are discussed. Both experiments were small by today's standards, had to be run with very limited access to the detector, and explored in detail the s dependence of a special feature of the p—p interactions. The application of these types of experiments to ISABELLE is considered.

33622 (CONF-770753—, pp 277-282) **Background problem for a large solid angle, high sensitivity detector.** Chen, M. (Massachusetts Inst. of Tech., Cambridge). 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

With extremely good vacuum (10^{-11} to 10^{-13} torr) and well controlled beams, the ISR has a good reputation for clean beam conditions and low background for most types of experiments. However, for a detector covering a large solid angle, measuring processes with small cross sections (approximately 10^{-38} cm^2) there are serious background problems which took almost a year to solve. Since ISABELLE may have similar problems, a summary is given of experience at the ISR with the hope that some of the solutions can be installed in ISABELLE at an early stage.

33623 (CONF-770753—, pp 283-287) **Operating modes for ISABELLE.** Cutts, D. (Brown Univ., Providence); Rosenberg, E.I. 18 Jul 1977.
From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The advantages of colliding beams with different energies and various experimental designs for this mode of operation are reviewed for the 400 GeV x 400 GeV ISABELLE. Allowed values of

energies, for both bunched and unbunched operation, are compared; allowed lab scattering angles are discussed; and typical maximum momentum asymmetries are tabulated. (PMA)

33624 (CONF-770753—, pp 287-290) **Notes on bunched beams in ISABELLE.** Marx, M. (Brookhaven National Lab., Upton, NY). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief summary is given of the advantages for experimentation at ISABELLE, when the machine is operated in a bunched beam mode. The capability for this mode can be incorporated into the ISABELLE design with minimal additional cost and effort.

33625 (CONF-770753—, pp 295-302) **Experimental support at proton—proton colliding beam facilities.** Potter, K. (European Organization for Nuclear Research, Brussels). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Proton—proton colliding beam facilities have a number of special features which increase the importance of support for experiments when compared to fixed target accelerators: (1) the laboratory system is very close to the center-of-mass system; this affects the geometry and general size of the experiments; (2) the primary p—p interaction is inaccessible, that is, it takes place in an ultrahigh vacuum chamber; and (3) the experiment detection system is necessarily inside the machine structure and becomes very closely linked to it in many respects. An overall picture is given of experimental support based on experience at the CERN ISR under the following headings: Experimental Areas, Scheduling, Intersection Vacuum Chambers, Machine Background, and Magnets for Experiments. The first two of these topics concern the requirements in space and time of an experiment, while the last three are all related to the close interaction between experiment and machine.

33626 (CONF-770753—, pp 303-306) **Mobility and powering of large detectors. Moving large detectors.** Thompson, J. (Univ. of Pittsburgh). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The possibility is considered of moving large lepton detectors at ISABELLE for readying new experiments, detector modifications, and detector repair. A large annex (approximately 25 m x 25 m) would be built adjacent to the Lepton Hall separated from the Lepton Hall by a wall of concrete 11 m high x 12 m wide (for clearance of the detector) and approximately 3 m thick (for radiation shielding). A large pad would support the detector, the door, the cryogenic support system and the counting house. In removing the detector from the beam hall, one would push the pad into the annex, add a dummy beam pipe, bake out the beam pipe, and restack and position the wall on a small pad at the door. The beam could then operate again while experimenters could work on the large detector in the annex. A consideration and rough price estimate of various questions and proposed solutions are given.

33627 (CONF-770753—, pp 306-307) **Viable modes of carrying out ISABELLE experiments.** Lederman, L.M. (Columbia Univ., New York). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

It is suggested that each experiment or array of experiments at ISABELLE (insofar as possible) should be mounted on railroad track, around a dedicated vacuum pipe, and should be capable of being rolled away from the machine, through a door in the concrete wall. It should be replaced by a dummy vacuum pipe via fixed vacuum gate valves or by another experiment.

33628 (CONF-770753—, pp 307-308) **Superconducting vs room temperature magnets at ISABELLE.** Thompson, J. (Univ. of Pittsburgh). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A brief comparison is made of superconducting and room temperature magnets for experiments at ISABELLE. Considerations include construction costs, operation costs, configuration, start-up time, quenching, and power costs. (PMA)

33629 (CONF-770753—, pp 323-325) **Small angle single arm spectrometer.** Yodh, G.B. (Univ. of Maryland, College Park). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

The upgrading of ISABELLE to 400 x 400 GeV has direct influence on the particle identifying capability of the small angle spectrometer which was designed to cover 20 to 200 GeV/c momentum range with three gas Cherenkov counters. A brief analysis shows, however, that no major detector modifications are necessary.

33630 (CONF-770753—, pp 334-337) **Proposal to install shielded repair areas at ISABELLE.** Dowd, J. (Southeastern Massachusetts Univ., North Dartmouth); Russell, J.J.; Potter, K.; Ryan, D.; Foley, K.J.; Ozaki, S.; Thorndike, A.M.; Willen, E.H. 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

A modification to the ISABELLE experimental halls is proposed which will increase the efficiency of machine operation and permit quicker and easier repair of apparatus. The cost is far smaller than that involved in mounting a large experiment at ISABELLE, so the improved turn-over is cost-effective.

33631 (CONF-770753—, pp 365-371) **Future possibilities: summary of activity.** Pondrom, L.G. (Univ. of Wisconsin, Madison). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

In ISABELLE, the basic machine will consist of two superconducting rings capable of storing and accelerating high currents of protons to energies up to 400 GeV, and colliding the two beams in six interactions. In order to broaden the experimental capability beyond p—p collisions, two possibilities have traditionally been considered in the past: (1) anti pp collisions, in which antiprotons are somehow stored and accelerated in one of the rings; and (2) ep collisions, in which a third ring is constructed to accelerate electrons. In the 1977 workshop, these two possibilities were reconsidered, the implications of the 400 GeV design were discussed, and some new conclusions were reached. The necessity for high luminosity in anti pp is emphasized, but a definitive best scheme for obtaining this luminosity has not been found. In ep a 20 GeV x 400 GeV combination is appealing, with electrons in a low field conventional ring in the ISABELLE tunnel. It is probably smoother to do ep and pp physics in separate running periods. Vertical crossing is preferred if the electrons are polarized. Synchrotron radiation in the intersecting region remains a problem for detailed design. Extrapolated rate estimates for interesting electromagnetic and weak processes look promising.

33632 (CONF-770753—, pp 372-374) **Antiproton storage: a comparison of proposals.** Pondrom, L.G. (Univ. of Wisconsin, Madison). 18 Jul 1977.

From Isabelle workshop; Upton, NY, USA (18 Jul 1977). In Proceedings of the 1977 Isabelle Summer Workshop.

Projects to produce and store anti p's and to accelerate anti p's and p's together in the same large ring are underway at CERN and FNAL. The goal is to achieve anti pp collisions with a luminosity L approximately 10^{30} cm^{-2} sec^{-1} by perhaps 1980. These experiments predate any similar effort at ISABELLE by at least four years, so it is necessary to plan an ISABELLE project which will have significantly higher luminosity. A lower bound L = 10^{31} cm^{-2} sec^{-1} has been rather arbitrarily chosen. The basic numbers which enter into the luminosity calculations for the CERN and FNAL proposals are presented and are compared with what could be achieved at ISABELLE under ideal conditions.

33633 (DOE/EIS—0003-D) **Draft Environmental Impact Statement: Proton—Proton Storage Accelerator Facility (ISABELLE), Brookhaven National Laboratory, Upton, New York.** (Department of Energy, Washington, D.C. (USA)). Jan 1978. 135p. Pennington, Office of NEPA Coordination, Washington, DC.

An Environmental Impact Statement is presented for a proposed research facility (ISABELLE) to be built at Brookhaven National Laboratory (BNL). It has been prepared by the Department of Energy (DOE) following guidelines issued for such analyses. In keeping with DOE policy, this statement presents a concise and issues-oriented analysis of the significant environmental effects associated with the proposed action. Critical review of the significant issues involved with this proposed action was greatly facilitated by the use of the BNL Site Environmental Impact Statement (ERDA 1540). This document provides background information about the Laboratory, and is frequently referenced in the report. ISABELLE is a proposed physics research facility where beams of protons collide providing opportunities to study high energy interactions. The facility would provide two interlaced storage ring proton accelerators, each with an energy up to 400 GeV intersecting in six experimental areas. The rings are contained in a tunnel with a circumference of 3.8 km (2.3 mi). The facility will occupy 250 ha (625 acres) in the NW corner of the existing BNL site. The proposed construction of the ISABELLE facility was examined in great detail. Potential environmental impacts were examined, and the relevant ones are described in this document. No serious detrimental environmental impact was discovered thatwould be created by the construction of ISABELLE.

INSTRUMENTATION

RADIATION INSTRUMENTATION

GENERAL DETECTORS AND MONITORS

REFER ALSO TO CITATION(S) 33048

33634 (ANL—77-XX-90) **Remote Working Level Monitor. Final report.** (Argonne National Lab., Ill. (USA)). 18 Nov 1977. Contract W-31-109-ENG-38. 167p. Dep. NTIS, PC A08/MF A01.

The Remote Working Level Monitor (RWLM) is an instrument used to remotely monitor the RN-daughter concentrations and the Working Level (WL). It is an ac powered, microprocessor based instrument which multiplexes two independent detector units to a single central processor unit (CPU). The CPU controls the actuation of the detector units and processes and outputs the data received from these remote detector units. The remote detector units are fully automated and require no manual operation once they are set up. They detect and separate the alpha emitters of RaA and RaC' as well as detecting the beta emitters of RaB and RaC. The resultant pulses from these detected radioisotopes are transmitted to the CPU for processing. The programmed microprocessor performs the mathematical manipulations necessary to output accurate Rn-daughter concentrations and the WL. A special subroutine within the program enables the RWLM to run and output a calibration procedure on command. The data resulting from this request can then be processed in a separate program on most computers capable of BASIC programming. The calibration program results in the derivation of coefficients and beta efficiencies which provides calibrated coefficients and beta efficiencies.

33635 (HEDL-SA—1302) **Programmable automatic alpha—beta air sample counter.** Howell, W.P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1978. Contract EY-76-C-14-2170. 6p. (CONF-780110—11). Dep. NTIS, PC A02/MF A01.

From 11. symposium on radiation instrumentation; San Diego, CA, USA (17 Jan 1978).

A programmable automatic alpha-beta air sample counter was developed for routine sample counting by operational health physics personnel. The system is composed of an automatic sample changer utilizing a large silicon diode detector, an electronic counting system with energy analysis capability, an automatic data acquisition controller, an interface module, and a teletypewriter with paper tape punch and paper tape reader. The system is operated through the teletypewriter keyboard and the paper tape reader, which are used to instruct the automatic data acquisition controller. Paper tape programs are provided for background counting, Chi^2 test, and sample counting. Output data are printed by the teletypewriter on standard continuous roll or multifold paper. Data are automatically corrected for background and counter efficiency.

33636 (LA-UR—78-26) **VORP, an improved detector system for remote measurements.** Smale, R.F.; Backsen, M.H.J. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 18p. Dep. NTIS, PC A02/MF A01.

The Voltage Output Radiation Probe (VORP) is used as the detector to monitor radiological data on underground nuclear tests at the Department of Energy (DOE) Nevada Test Site. The VORP was designed to convert the current output of a Neher-White ionization chamber to a voltage output. There are several advantages in having a voltage output device rather than a low current probe in the field. The VORP makes it easier to protect against transients induced in the field wires. It also allows the use of redundant (parallel) data acquisition equipment without having to duplicate each field probe. The electronics was designed to operate off of a self-contained 1.35-volt battery and was fabricated using thick film hybrid circuit technology.

33637 (SLAC-PUB—1783) **Photon response of silicon diode neutron detectors.** McCall, R.C.; Jenkins, T.M.; Oliver, G.D. Jr. (Stanford Linear Accelerator Center, Calif. (USA); Mallinckrodt Inst. of Radiology, St. Louis, Mo. (USA)). Jul 1976. Contract EY-76-S-03-0326. 16p. (CONF-760741—2). Dep. NTIS, PC A02/MF A01.

From 4. international conference on medical physics; Ottawa, Canada (25 Jul 1976).

The photon response of silicon diode neutron detectors was studied to solve the problem on detecting neutrons in the presence of high energy photons at accelerator neutron sources. For the experiment Si diodes, Si discs, and moderated activation foil detectors were used. The moderated activation foil detector consisted of a commercial moderator and indium foils 2" in diameter and approximately 2.7 grams each. The moderator is a cylinder of low-density polyethylene $6^1/_4$" in diameter by $6^1/_{16}$" long covered with 0.020" of cadmium. Neutrons are detected by the reaction $^{115}In(n,\gamma)^{116}In$(T/sub $^1/_2$/ = 54 min). Photons cannot be detected directly but photoneutrons produced in the moderator assembly can cause a photon response. The Si discs were thin slices of single-crystal Si about 1.4 mils thick and 1" in diameter which were used as activation detectors, subsequently being counted on a thin-window pancake G.M. counter. The Si diode fast neutron dosimeter 5422, manufactured by AB Atomenergi in Studsvik, Sweden, consists of a superdoped silicon wafer with a base width of 0.050 inches between two silver contacts coated with 2 mm of epoxy. For this experiment, the technique of measuring the percent change of voltage versus dose was used. Good precision was obtained using both unirradiated and preirradiated diodes. All diodes, calibrated against ^{252}CF in air,were read out 48 hours after irradiation to account for any room temperature annealing. Results are presented and discussed. (WHK)

RADIATION DOSEMETERS

33638 (LA-UR—78-40) **Neutron response of a new albedo-neutron dosimeter.** Blackstock, A.W.; Cortez, J.R.; Littlejohn, G.J.; Storm, E. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 18p. (CONF-780110—8). Dep. NTIS, PC A02/MF A01.

From 11. symposium on radiation instrumentation; San Diego, CA, USA (17 Jan 1978).

The Los Alamos Scientific Laboratory is converting from a film badge to a badge containing thermoluminescent dosimeters (TLD's). The new dosimeter consists of a plastic badge holding an aluminum card which contains three TLD-700 and one TLD-600 Harshaw LiF chips. In the albedo-neutron portion of the badge, based on Hankins' design, the TLD-600 and one TLD-700 chips are shielded from thermal neutrons by 0.026-inch-thick cadmium. From the difference in readings of these two TLD's, the neutron dose is estimated. There is also a detachable holder for NTA film if needed to cover the neutron energy range not covered by the albedo-neutron badge. The neutron energy response of the new badge was measured, using monoenergetic sources over the range from 0.1 to 14 MeV and is compared with a calculated response over this range. Since NTA film cannot detect proton recoils from neutrons with energies less than 0.7 MeV, a primary advantage of the TLD albedo-neutron badge is its ability to record neutrons down to the cadmium cutoff. However, a major disadvantage is its sharp decrease in sensitivity with increasing energy. Data are given showing this. Using a BF_3 detector inside 9-inch and 3-inch polyethylene spheres containing cadmium, Hankins developed a method for applying energy calibration factors to the albedo-neutron TLD badge readings. This method is based on two premises: first, that the response in rem of the 9-inch sphere is independent of energy and second, that the response of the 3-inch sphere is similar to that of the TLD albedo-neutron badge. Measurements to test the validity of these premises are reported. The method requires initial 9-inch to 3-inch sphere ratios to be measured in each area where neutrons are encountered and periodic checks to detect changes which may occur.

NUCLEAR SPECTROSCOPIC INSTRUMENTATION

33639 (UCRL—52378) **PLS: an interactive routine to plot, list, and analyze multichannel pulse-height-analyzer data.** Bennett, D.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Nov 1977. Contract W-7405-ENG-48. 27p. Dep. NTIS, PC A03/MF A01.

PLS is an interactive routine to plot, list, and analyze multichannel pulse-height-analyzer data. From 256 to 4096 channels of data can be read from a direct-access file on disk or from a directory-headed magnetic tape. Data are plotted and manipulated interactively on a graphic terminal; listings are displayed on either a graphic terminal or a printer-plotter.

HIGH ENERGY PHYSICS INSTRUMENTATION

REFER ALSO TO CITATION(S) 33596, 33597, 33598, 33600, 33601, 33602, 33603, 33604, 33605, 33606, 33614, 33615, 33616, 33626, 33629

33640 (CONF-771023—10) **High efficiency detectors for time-of-flight with high energy neutrons.** Goodman, C.D.; Rapaport, J.; Bainum, D.E.; Greenfield, M.B.; Goulding, C.A. (Oak Ridge National Lab., Tenn. (USA); Ohio Univ., Athens (USA); Florida Agricultural and Mechanical Univ., Tallahassee (USA)). 1977. Contract W-7405-ENG-26. 5p. Dep. NTIS, PC A02/MF A01.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1977).

Experience in achieving sub-nanosecond time resolution with neutrons about 100 MeV on a scintillation detector 15 x 15 x 100 cm viewed by a single phototube is discussed. Time compensation is accomplished by tilting the scintillator axis with respect to the neutron flight path as discussed previously. The interplay between the time compensation from the geometry of light collection and the electronic technique for picking off the time signal is described.

33641 (LA—7143) **Event matrix system.** Dalton, C.G. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 5p. Dep. NTIS, PC A02/MF A01.

The number of background events in nuclear and particle physics experiments which use multiwire proportional chambers can be extremely high. Using a computer to resolve these events results in a high deadtime for the experiment. A fast matrix system for decreasing the number of background events is described in this report. 4 figures.

RADIOMETRIC INSTRUMENTS

33642 (N—77-28152) **Orbital construction demonstration study. Volume 2: technical. Final report.** (Grumman Aerospace Corp., Bethpage, N.Y. (USA)). Jun 1977. Contract NAS9-14916. 342p. NTIS PC A15/MF A01.

The following items are discussed in reference to OCDA requirements; (1) flight mechanics and control, (2) effects of sun angle, (3) disturbance torques, (4) control system requirements, (5) OCDA orbit decay profile, and (6) aerodynamic drag forces. Structural design requirements are also given as well as basic design definition.

33643 **Chemical change measuring apparatus.** Belcher, R.L. US Patent 4,066,897. 3 Jan 1978. Filed date 25 Feb 1976. 10p.

Means for testing to determine the residual recoverable energy of a battery of cells or a single cell, without requiring any electrical connection to the battery or the addition of special materials, substances, or devices to the intrinsic cell, and, therefore, to determine the remaining useful life of the battery or single cell are considered. Two different embodiments, both of which rely on the fact that the electrodes of a battery or cell undergo chemical change during discharge, are disclosed. In the first embodiment, gamma radiation is transmitted through an electrode of the battery or cell, and the level of the radiation exiting from the electrode is measured. This measurement is correlated with a known value obtained for that battery or cell before discharge has taken place. The second embodiment utilizes a beta or photon backscattering technique. A battery or cell undergoing test is subjected to beta or photon radiation and the backscatter is measured. This backscatter measurement is correlated with the value obtained from the backscatter measurements taken before any discharge of that battery or cell has taken place. 3 figures.

RADIATION EFFECTS ON INSTRUMENT COMPONENTS, INSTRUMENTS, OR ELECTRONIC SYSTEMS

33644 (PEM—59) **Grounding requirements for protection of transportable satellite communication terminals.** Getson, W.J. (Electronic Systems Div., Melbourne, Fla. (USA)). Aug 1977. Contract W-7405-ENG-48-EC-301. 41p. Dep. NTIS, PC A03/MF A01.

Existing theoretical and experimental knowledge concerning grounding requirements for the protection of structures in general can be implemented for the special case of the transportable SATCOM terminal. A description of a typical SATCOM terminal and terminal specifications are presented. General protection requirements are that transportable SATCOM terminals must meet performance requirements, must not be damaged by direct lightning strokes, must not be degraded beyond allowable tolerances due to effects of an electromagnetic pulse (EMP), and must be safe for personnel working in and around the terminal. An adequate grounding system is described, including a description of site fields. Lightning protection for antenna structures, equipment shelters, combined protection, power modules, and electrical surge arrestors are covered, as is EMP protection for antenna structures, equipment shelters, and power modules, with emphasis on electrical surge arrestors, cable shields and connectors, and cable routing. Examples of grounding systems for two configurations of transportable SATCOM terminals are compared. The same principles which protect powerlines, radio and TV transmission towers, houses, etc., from the effects of lightning need to be adapted and incorporated to the greatest extent possible to protect transportable SATCOM terminals. With additional adaptations, these same principles also provide protection against the effects of EMP. The crucial protection in both cases is grounding.

MISCELLANEOUS INSTRUMENTS

REFER ALSO TO CITATION(S) 32627, 33402, 33488, 33673, 33674

33645 (DOE/EV—0009) **Supplement to CAMAC standards and reports. Computer automated measurement and control.** (National Instrumentation Methods Committee (USA)). Mar 1978. 16p. Dep. NTIS, PC A02/MF A01.

Several Department of Energy and IEEE Standards and reports are concerned with the CAMAC modular instrumentation and digital interface system. Since, these documents are under continual review, clarifications, corrections and modifications are made from time to time. This supplement compiles all such material in a single document that is to be revised and reissued as necessary.

33646 (IS—4309) **Transmission line filter for nuclear magnetic double resonance experiments.** Murphy, P.D.; Gerstein, B.C. (Ames Lab., Iowa (USA)). [nd]. Contract W-7405-ENG-82. 12p. Dep. NTIS, PC A02/MF A01.

A simple, inexpensive transmission line filter is described. The unit will pass 14 MHz with 0.15 db loss per section, and attenuate 56 MHz with 20.5 db attenuation per section.

33647 (SAND—77-1845C, pp 616-630) **Photographic print digitizer.** Evans, T.L. 1977.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

In Proceedings of the digital signal processing symposium.

A photographic print digitizer which uses a Fairchild CCD-131 linear image sensing device for scanning the print was developed. This system can digitize and store a maximum of two traces from a photographic print. In most cases, prints with or without graticule lines can be digitized with this device. A PDP 11/04 is used to evaluate the digitized data from this system. 4 figures.

33648 (SAND—77-1845C, pp 646-667) **Digitizer applications at GEND.** Howell, J.; Wells, T. (General Electric Co., St. Petersburg, FL). 1977.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

In Proceedings of the digital signal processing symposium.

Approximately thirty Biomation, Model 8100, Transient Recorders (Digitizers) are utilized at GEND in product testers to measure input stimulus and/or output response. The number of digitizers varies from one to eight per tester. GEND-developed hardware for use with digitizers, providing interfacing, calibration, control, and signal switching, is discussed. The kind of tester software to support digitizers, its features, and development history are also discussed. 14 figures.

33649 (SAND—77-1858C) **Stand-alone signal processing system for algorithm development.** Jacklin, W.L. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 30p. (CONF-771206—12). Dep. NTIS, PC A03/MF A01.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

The Air Force Base and Installation Security Systems (BISS) Program is funding a project at Sandia Laboratories in Albuquerque to improve the performance of perimeter intrusion detection sensors by using state-of-the-art signal processing techniques. The project has concentrated on the development of adaptive digital algorithms with the intent of improving the signal-to-noise ratio by minimizing noise. In the spring of 1976, personnel assigned to this project began investigating adaptive digital filters using the Sandia PDP-10 time-sharing system. These algorithms were further refined and enhanced during the summer as the theoretical foundations for the adaptive process were developed. It soon become obvious that the development of successful algorithms required extensive testing with real-world signals. This required the acquisition of a dedicated general-purpose computer system capable of rapid turnaround with compute-bound processes on large data files. This ultimately resulted in the acquisition of a DEC PDP-11/34 system. A framework for the development of new algorithms in a logically consistent manner is described.

33650 (SAND—77-1859C) **Hardware implementation of adaptive filtering using charge-coupled devices.** Donohoe, G.W. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1977. Contract EY-76-C-04-0789. 15p. (CONF-771206—7). Dep. NTIS, PC A02/MF A01.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

Sandia Laboratories' Digital Systems Division/1734, as part of its work on the Base and Installation Security Systems (BISS) program has been making use of adaptive digital filters to improve the signal-to-noise ratio of perimeter sensor signals. In particular, the Widrow-Hoff least-mean-squares algorithm has been used extensively. This non-recursive linear predictor has been successful in extracting aperiodic signals from periodic noise. The adaptive filter generates a predictor signal which is subtracted from the input signal to produce an error signal. The value of this error is fed back to the filter to improve the quality of the next prediction. Implementation of the Widrow adaptive filter using a Charge-Coupled Device tapped analog delay line, analog voltage multipliers and operational amplifiers is described. The resulting filter adapts to signals with frequency components as high as several megahertz.

33651 (SAND—78-0097) **Overview of the Division 2351 Neutron Generator Test Facility waveform digitizing system.** Bryant, T.C. Jr. (Sandia Labs., Albuquerque, N.Mex. (USA)). Feb 1978. Contract EY-76-C-04-0789. 36p. Dep. NTIS, PC A03/MF A01.

All neutron generator waveforms from units tested at the SLA neutron generator test site are digitized and the digitized data stored in the CDC 6600 tape library for display and analysis using the CDC 6600 computer. The digitizing equipment consists mainly of seven Biomation Model 8100 transient recorders, Digital Equipment Corporation PDP 11/20 computer, RK05 disk, seven-track magnetic tape transport, and appropriate DEC and SLA controllers and interfaces. The PDP 11/20 computer is programmed in BASIC with assembly language drivers. In addition to digitizing waveforms, this equipment is used for other functions such as the automated testing of multiple-operation electronic neutron generators. Although other types of analysis have been done, the largest use of the digitized data has been for various types of graphical displays using the CDC 6600 and either the SD4020 or DX4460 plotters.

33652 (UCRL—52387) **Dynamic control of fracture experiments with complex specimens: design and analysis of tight controllers.** Corynen, G.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 Jan 1978. Contract W-7405-ENG-48. 102p. Dep. NTIS, PC A06/MF A01.

Using control theory concepts that relate to the design of a closed-loop system, a specific control system problem dealing with controlling crack propagation in solid specimens is analyzed. In the process of analyzing this problem, it is shown how general control theory concepts work to solve a specific problem. This is done in a tutorial manner to aid experimentalists who may not be familiar with the control theory concepts relevant to their work. Starting with a preliminary design using available equipment, all parts and their relationship to the whole are analyzed. Studies on improving the weakest subsystem, the servovalve driver, on reducing the total error in the system, and on obtaining a stiff system (insensitive to specimen dynamics) are described. An important feature in the control strategy was a particular mix of force feedback and feedforward load-cancellation control, which not only provided a highly responsive and flexible system, but was essential in obtaining a stiff system. With linear and nonlinear stability criteria, it is shown that the linear version of the system has comfortable phase and gain margins and that the complete nonlinear system exhibits a stable and acceptable limit cycle. In addition to expressions for system stiffness that are valid when the specimen dynamics are unknown, an expression is developed that explicitly accounts for the influence of load compliance on overall system compliance. At this point, the system, although not yet in its final stage, is extremely stiff and strongly resistant to any loading effects. It has zero steady-state effort to step and ramp inputs, and servovalve saturation is the principal contributor to dynamic errors. Areas that need further study are outlined such as specimen behavior sensing, experimental validation of the design, and computation and simulation of the model.

33653 (WAPD-TM—1252) **Bonded resistance strain gage applications.** Mutter, J.E. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Mar 1978. Contract EY-76-C-11-0014. 31p. Dep. NTIS, PC A03/MF A01.

The practical experience and engineering techniques in the past decade to assure proper application and accurate data from bonded resistance strain gages are summarized. The underlying principles of strain gages are described, along with typical applications and the ever-present and sometimes subtle problems of temperature compensation, lead wire errors, gage factors, etc. Various hookup arrangements are explained, showing how strain gages can be used to determine bending, torque, tension, compression and shear forces. This report is intended to provide a general guide on strain gage applications and to assist in overcoming some of the potential problems that arise in their use.

33654 (LA-tr—78-23) **Real time digital sampler.** 1978. Translation of French report. 23p. Dep. NTIS, PC A02/MF A01.

Portions of document are illegible.

Improvement in precision of measurements is a difficult problem in chronometry and in multichronometry. Systems of fine chronometry were designed which play the role of "vernier" for devices counting clock pulses at a frequency of 100 MHz or higher. In this way, chronometers and multichronometers with resolution of 1 ns or 100 ps have been able to be made or are in progress at DAM/DT/DEV/An L. It is shown how, going from the "systems of fine chronometry to low dead time," it is possible to conceive real time samplers. Topics include: (1) the principle and functioning of chronometers for fragments of a line at one, two or n levels; (2) the principle of the real time samplers in amplitude-time conversion; (3) analysis of the head of the amplitude-time conversion; (4) presentation and characteristics of two versions of the "real time samplers"; and (5) eventual improvements.

33655 (UCRL-Trans—11335) **Assessment of the engineering level and quality of certain types of products of Geofizika Scientific Production Association.** Alekseeva, G.D. Translated from *Geofiz. App.;* No. 59, 177-186(1976). 16p. Dep. NTIS, PC A02/MF A01.

USSR state standards for quality control of manufactured goods (particularly instruments) are briefly discussed. Data on the performance of various foreign and domestic magnetometers are presented and discussed. (WHK)

33656 (ORNL-tr—4575) **Storage of measured values with the PCM method on magnetic tape cassettes.** Glockmann, H.P. Translated by D.M. Jacobson from *Mess. Pruef.;* No. 9, vp(1975). 20p. Dep. NTIS, PC A02/MF A01.

The magnetic tape recording of analog signals by the PCM method--for example measuring data--offers considerable technical and cost advantages over the conventional FM technique. The most recent instruments in a family of PCM systems provide the additional advantages of the so-called compact cassette--mechanical protection of the data carrier, easy handling and filing--and are thus useful in measurement technology for the simultaneous recording of 8 to 16 data channels.

WELL LOGGING INSTRUMENTATION

REFER ALSO TO CITATION(S) 32723, 32933

33657 **Accuracy of specialized digital processing of industrial geophysics data.** Golubev, E.G.; Zinchenko, A.I. *Prikl. Geofiz.;* No. 84, 210-218(1976). (In Russian).

Problems in the accuracy of specialized digital computers used for the rapid processing of logging data are examined during the recording process. Formulas were obtained for the mean error and its dispersion caused by rounding-off in the computer during the execution of simple algorithms and the computation of elementary functions. The indicated formulas can be used for designing operational computer devices. 2 tables, 5 titles.

EXPLOSIONS AND EXPLOSIVES

CHEMICAL

REFER ALSO TO CITATION(S) 32628, 32636, 32679

33658 (UCID—16077-78-1) **Hard Structure Munition Project (U). HMS progress report No. 69, 1—31 January 1978.** Walker, F.E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Feb 1978. Contract W-7405-ENG-48. 13p. Dep. NTIS, PC A02/MF A01.

Research progress is reported on the warhead effort and safety analysis. Generator output data from AEDC wind tunnel tests are presented in an appendix. (TFD)

33659 **Explosion containment device.** Benedick, W.B.; Daniel, C.J. (to Energy Research and Development Administration). US Patent 4,055,247. 25 Oct 1977. Filed date 22 Oct 1976. 4p.

PAT-APPL-734,834.

An explosives storage container is described for absorbing and containing the blast, fragments and detonation products from a possible detonation of a contained explosive. The container comprises a layer of distended material having sufficient thickness to convert a portion of the kinetic energy of the explosion into thermal energy. A continuous wall of steel sufficiently thick to absorb most of the remaining kinetic energy by stretching and expanding, thereby reducing the momentum of detonation products and high velocity fragments, surrounds the layer of distended material. A crushable layer surrounds the continuous steel wall and accommodates the stretching and expanding thereof, transmitting a moderate load to the outer enclosure. These layers reduce the forces of the explosion and the momentum of the products thereof to zero. The outer enclosure comprises a continuous pressure wall enclosing all of the layers. In one embodiment, detonation of the contained explosive causes the outer enclosure to expand which indicates to a visual observer that a detonation has occurred.

NUCLEAR

REFER ALSO TO CITATION(S) 33226, 33636

WEAPONRY

REFER ALSO TO CITATION(S) 33239

33660 (SAND—78-8212) **Graphics for the hybrid stores separation simulation of the B77 system.** Marmon, R.G. (Sandia Labs., Livermore, Calif. (USA)). Mar 1978. Contract EY-76-C-04-0789. 43p. Dep. NTIS, PC A03/MF A01.

The B77 is pictorially illustrated with the B52, F111, F4 and A7 aircraft in hybid simulations. The design goals are covered and pictorial plots are given to verify the results. Actual flight test film is compared to a simulation with good results. This same program can be modified for other users that desire to display their simulation data in the SLL Flight Dynamics Laboratory.

33661 (SAND—78-8668) **Hybrid trajectory simulation of a parachute system.** Bolton, W.R. (Sandia Labs., Livermore, Calif. (USA)). Apr 1978. Contract EY-76-C-04-0789. 22p. Dep. NTIS, PC A02/MF A01.

Sandia laboratories has developed a parachute system which allows delivery of a payload from high speed and very low altitude while providing an acceptable low impact velocity. A hybrid computer simulation of the parachute delivery system is described.

33662 (UCRL-Trans—11345) **Atomic bombs.** Martinez, F.P. Translated from *Energ. Nucl. (Madrid);* **5**: 4-12(1961). 22p. NTIS, MF A01.

Portions of document are illegible.

A general description of the various types of atomic bombs and their working parameters is presented. (TFD)

EXPLOSION DETECTION

33663 (AD—045096) **Teleseismic p-wave amplitudes and spectra at nts and at the shoal site as compared to those observed in eastern north america. Preliminary technical report.** Der, Z.A.; Dawkins, M.S.; McElfresh, T.W.; Goncz, J.H.; Gray, C.E. (Teledyne Geotech, Alexandria, Va. (USA). Seismic Data Lab.). 2 Sep 1977. Contract F08606-77-C-0014,. 44p. (SDAC-TR—77-9). NTIS PC A03/MF A01.

Three Special Data Collection System (SDCS) stations were deployed at NTS to Measure magnitude residuals and spectral differences relative to two Eastern United States (EUS) stations in order to determine the degree of anelastic attenuation under NTS. At the NTS station located on the Climax stock (OB2NV), the average teleseismic body-wave magnitude is .13 magnitude units (m.u.) lower than at HNME and .19 m.u. lower than at RKON. The magnitudes at the two Pahute Mesa sites average .25 m.u. higher than at OB2NV, but calculations show that most of the difference can be attributed to site amplification by low velocity volcanics under Pahute Mesa. At all NTS sites the high frequency content of P-waves is less than at RKON; the difference is statistically significant for two of the three NTS stations, and marginally significant at the third. Measurements at the site of the SHOAL explosion yield similar figures, showing lower high frequency content and lower magnitudes of P-waves relative to EUS. The above results are indicative of anelastic losses of body-waves traversing the mantle under both test sites.

ENVIRONMENTAL SCIENCES, ATMOSPHERIC

BASIC STUDIES

33664 (ANL—76-88(Pt.4)) **Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.** (Argonne National Lab., Ill. (USA)). 1976. Contract W-31-109-ENG-38. 188p. Dep. NTIS, PC A09/MF A01.

Separate abstracts were prepared for 23 sections of this report on meteorology and atmospheric physics research programs at ANL.

33665 (ANL—76-88(Pt.4), pp 1-6) **Outline of the 1976 Sangamon field experiment.** Sisterson, D.L.; Hicks, B.B.; Wesely, M.L. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The 1975 Sangamon investigation of the Planetary Boundary Layer (PBL) was a contribution to the Multistate Atmospheric Power Production Pollution Study. The 1975 experiment focused attention on the breakup of the nocturnal inversion. Preliminary analyses of the 1975 data suggested that the wind and temperature structure within the PBL frequently becomes layered in the strongly stable conditions often encountered at night. Obviously, the horizontal transport of pollutants in the atmosphere will be affected by the presence of any such layering phenomenon. Contaminants introduced into such strongly stratified flow will be free to be transported for considerable distances with little dilution, since vertical mixing is small. High concentrations of pollutants in thin strata are often observed n the troposphere above the mixing layer, where the atmosphere is more consistently stable. Moreover, numerical simulations of pollutant dispersion within the stable nocturnal PBL show thin layers of high concentrations of pollutants. The formation of the nocturnal inversion and the associated fine atmospheric structure were studied during 1976. The experiment using sulfur oxide transport was conducted over flat corn and soybean fields, approximately 35 km south of Springfield, Illinois, in Sangamon County. 1 figure.

33666 (ANL—76-88(Pt.4), pp 7-13) **Preliminary analysis of the Sangamon data.** Yamada, T.; Sisterson, D.L.; Hess, G.D. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The 1975 data from the Sangamon experiment were collected during the periods between 0400 and 1200 hours to investigate the evolution of the Planetary Boundary Layer (PBL) capped by an inversion layer. The 1976 experiment was conducted during the periods between 1600 and 2400 hours, in order to study the formation and development of the surface inversion layer. Turbulence intensity in the surface inversion is greatly reduced due to the consumption of the turbulent energy by work against the stable stratification. Moreover, turbulence is confined to a thin surface layer (<300 m), and a calm laminar layer forms above. Consequently, the surface inversion layer decouples from the rest of the PBL. Nocturnal low-level jets, frequently observed around midnight, are known to be the result of this decoupling of the two layers. Low turbulence intensity during the nighttime obviously has a great influence on the vertical diffusion of air pollution. Pollutants will be transported greater distances downwind and with much less dilution at night than in the daytime. Results of the preliminary analysis of about 70 hours of wind and temperature data available from the 1975 experiment are discussed.

33667 (ANL—76-88(Pt.4), pp 14-17) **Analysis of what system data for 1975.** Sisterson, D.L.; Yamada, T.; Hess, P..; Hess, G.D+. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

Recent investigations of the behavior of the planetary boundary layer have centered around the use of the WHAT system, which provides a unique experimental capability for observing the detailed structure of wind, height, and temperature aloft. Analysis of the data obtained by use of the WHAT system necessarily follows the guidelines set down for other double-theodolite applications. However, the large quantity of data collected by the WHAT system and the need for rapid data reduction have required the development of rather involved techniques for computer analysis. These methods are described in sufficient detail that they may be reproduced elsewhere, should the need arise.

33668 (ANL—76-88(Pt.4), pp 29-31) **Studies of diffuse and direct solar radiation over snow.** Wesely, M.L.; Everett, R.G. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

Two interesting questions can be addressed by examination of solar radiation records obtained while the surface is covered with snow. One concerns the extent to which airborne particulate matter affects solar radiation received at the surface during winter conditions that are typical of those in the northeastern quarter of the United States. The other relates to the importance of complicated light scatterng in the earth-atmosphere system when the surface albedo is large. With the snow surface reflecting 50% or more of the incident radiation, it is likely that a significant addition to diffuse radiation would result from light that is reflected from the surface and then scattered back to the earth by the atmosphere. Preliminary data from measurements made during the winter of 1975 to 1976 are reported.

33669 (ANL—76-88(Pt.4), pp 38-41) **Optimal placement of sensors.** Shannon, J.D. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The objective sensor-placement technique will aid scientific investigation only to the extent that there is cooperation and communication between the experimental designer and the experimentalist. If properly appled, the technique is effective scientifically and financially, with the results available before deployment of any sensors.

33670 (ANL—76-88(Pt.4), pp 98-103) **Wind-tunnel study of turbulence generated by a building.** Sheih, C.M.; McHenry, J.N. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The preliminary results of a study of a study of turbulence behind on obstruction appear to indicate that turbulence generated by a building can be related to the drag force of a building through a constant of proportionality which is found to be 0.014 in the present study. However, in order to generalize the present finding, more

experiments will have to be conducted using wide range of building shapes, tunnel velocities, and values of Reynolds number.

33671 (ANL—76-88(Pt.4), pp 114-123) **High-frequency tempearture and humiditiy correlation above a warm water surface.** Wesely, M.L.; Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

In order to use visual observations of atmospherically-induced image blurring for the evaluation of vertical heat fluxes in the surface boundary layer over warm water surfaces, estimates of the extent of correlation between temperature and humidity fluctuations at high, inertial-subrange frequencies are needed. Temperature and absolute humidities were measured above the warm water surface of the cooling lake of the Dresden nuclear facility near Morris, Illinois, to determine the individual contributions of temperature and humidity fluctuations to optical refractive index fluctuations. Data collection techniques are described.

33672 (ANL—76-88(Pt.4), pp 124-126) **Note on the use of the Sheppard approximation in bulk aeroynamic applications.** Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The benefits resulting from the use of the Sheppard (1958) approximation for the roughness length for water vapor and sensible-heat transfer over open water surfaces permits ready application of the bulk aerodynamic method to data obtained at nonstandard heights in unusual stability conditions. At the same time, for routine application to data collected at 10 m height at sea, the simplification results in an effective bulk transfer coefficient of about 0.00145, which is well within the scatter of experimental determinations for both heat and moisture. It is pointed out that the formulation is an approximation whose principal values are its simplicity and its apparent agreement with oceanic data.

33673 (ANL—76-88(Pt.4), pp 127-132) **Some preliminary results from the 1976 ITCE. I. Anemometry.** Hicks, B.B.; Frenzen, P.; Wesely, M.L. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The October 1976 International Turbulence Comparison Experiment (ITCE) was the most recent of a series of collaborative studies that has been gradually expanding in scope over the last decade. The experiment was hosted by the Australian Commonwealth Scientific and Industrial Research Organization, Division of Atmospheric Physics (DAP), at a site near Conargo, about 40 km east of Deniliquin, N.S.W. Scientific teams from Japan, Canada, U.S.A., U.S.S.R., and Australia took part. Analysis of the large body of data collected during the ITCE is continuing, and this report deals with some of the peripheral efforts that yielded rapid answers. Results of performance testing of commercial anemometers are discussed.

33674 (ANL—76-88(Pt.4), pp 133-139) **Preliminary results from the 1976 ITCE. II. Temperature and humidity variables.** Wesely, M.L.; Hicks, B.B.; Frenzen, P. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The objectives of the International Turbulence Comparison Experiment (ITCE) included an experimental comparison of fast-response humidity and temperature sensors, especially as they are used in eddy-correlation and high-frequency indirect measurements of the vertical heat fluxes. Hygrometry was emphasized rather than thermometry, since accurate fast-response temperature sensors are constructed and deployed with relative ease. As a result of the difficulty in detecting fast fluctuations of humidity, it is important that sensors suitable for application in studies of the latent-heat flux be tested and improved.

33675 (CONF-771163—1) **Locating critical natural features information for environmental planning.** Pardue, J.W.; Olson, R.J.; Burgess, R.L. (Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 12p. Dep. NTIS, PC A02/MF A01.

From Geographic data handling for rare plant conservation; New York, NY, USA (16 Nov 1977).

Information on critical natural features (such as rare species, wilderness areas, critical habitats, and endangered ecosystems) needs to be readily available to planners early in their activities to help identify and mitigate potential environmental impacts. Much of this information is dispersed among a confusing variety of agencies, organizations, groups, and individuals, and is not readily available. Needed facts about the natural features of an area are often discovered only after considerable effort has been expended on planning, design, and construction. ORNL is attempting to facilitate this information transfer by developing an interface between prime sources and those who legitimately need the information. With the planned interactive computer system, a user could request information concerning critical natural features of a region, county, or subcounty unit and receive a list of brief descriptions of these features coupled with a list of contacts for more detailed information. References will also be supplied from a growing bibliographic data file on nature conservation. Natural features information would be used to amplify natural resource information that has been compiled at the county level by the Geoecology Project at ORNL for use in integrated regional assessments of energy facilities.

33676 (NTIS/PS—77/0912) **Air pollution effects on materials (a bibliography with abstracts). Report for 1964-Sep 77.** Reed, W.E. (National Technical Information Service, Springfield, Va. (USA)). Oct 1977. 132p.

The bibliography contains selected research reports on corrosion and damage by air pollution and includes studies on the effects upon steel, textiles, and building materials. Many studies cover a specific pollutant and its corrosive or damaging properties. (This updated bibliography contains 127 abstracts, 34 of which are new entries to the previous edition.)

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 32596, 32608, 32613, 32977, 33487, 33491, 33575, 33578, 33580, 33664, 33665, 33666, 33668, 33728, 33731, 33933, 33987, 33993, 33995, 33996, 33998, 34003

33677 (ANL—76-88(Pt.4), pp 18-23) **Detection of a large industrial plume by an acoustic sounder.** Miller, E.L. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

This detection of a large buoyant plume with an acoustic sounder suggests a possible observational role for acoustic sounders in plume-rise investigations. Such remote-sensing techniques might be particularly useful for observations at night or for long-term studies in which the capability for long periods of unattended operation would be valuable. The question of whether the enhancement of the echoes by condensation is necessary for the plume to be detected is still unanswered, as are the attendant questions of the usefulness of the device for detecting dry plumes or for observations at greater distances from the source.

33678 (ANL—76-88(Pt.4), pp 24-28) **Acoustic-sounder investigation of the effects of boundary-layer decoupling on long-distance polutant transport.** Miller, E.L. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The formation of the nocturnal surface temperature inversion results in a decrease in vertical momentum transfer which, in turn, is accompanied by an associated reduction in the transfer of pollutants from the atmosphere to surface sinks, thus decoupling the surface layer from the layer above the inversion. The diurnal oscillation in the surface temperature profiles may therefore have a significant effect upon the transport of atmospheric pollutants over long distances. Flights of a large manned balloon with a diverse array of chemical and meteorological instrumentation aboard, known as Project de Vinci, provided a unique opportunity to combine acoustic-sounder observations of qualitative temperature structure in the atmospheric boundary layer with the chemical measurements necessary to gain increased understanding of this decoupling process and its consequences for pollutant transport. The data collected on ozone on the balloon and the grounds are reported.

33679 (ANL—76-88(Pt.4), pp 32-37) **Optimal selection of sites in a regional turbidity network.** Shannon, J.D.; Wesely, M.L. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

Atmospheric turbidity, when measured at the surface of the earth by use of observations of solar radiation, provides an indication of the amount of particulate matter averaged vertically in the atmosphere. In the northeastern quarter of the United States, the particulate matter frequently results from transformation of SO_2 and other compounds emitted at the surface at distances of about 1000 km from the point of measurement. This regional-scale transport is a subject of study in MAP3S, and it is the present purpose to design a network in the Northeast for turbidity sensors in order to provide information on the temporal and spatial distribution of increased turbidity, mostly due to haze. Although the instrument chosen to measure turbidity, the dichopyranometer, is inexpensive and easy to deploy, the number of instruments available is small. Thus, it is vital to position them in an optimal fashion. An objective sensor-placement technique is discussed.

33680 (ANL—76-88(Pt.4), pp 42-50) **Design of experiments for regional-scale atmospheric pollutant transport and transformation.** Sheih, C.M.; Hess, G.D.; Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

Experiments requiring air-pollution networks can be classified into two categories according to their purpose, namely, tracer experiments for studying mechanisms governing the life cycle of pollutants and air-quality measurements for assessment and characterization purposes. Design criteria for tracer experiments are deduced from an examination of the observations required to test the numerical simulations currently available or being developed. For air-quality measurements, design procedures are developed from an evaluation of the requirements for reproducing the overall pattern of pollutant concentration with a minimum number of sampling stations.

33681 (ANL—76-88(Pt.4), pp 51-55) **Temporal sampling requirements for long-term dispersion.** Sheih, C.M.; Hess, G.D. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

A statistical sampling theory proposed by Lumley and Panofsky was used to analyze simulated regional-scale trajectories released from a point source near St. Louis. The results show that the required sampling interval ranges from 20 to 49 h for long-term average pollutant concentration. The corresponding required averaging time, weighted by the square of the acceptable error, varies from 13 to 29 h. As an example, with the error assumed to be 10%, the most critical case requires 121 days averaging time and a sampling interval of 49 h.

33682 (ANL—76-88(Pt.4), pp 56-62) **Relative importance of single-particle and relative diffusion for plume dispersion.** Sheih, C.M. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

The concepts of single-particle diffusion, relative diffusion, and meandering motion of a plume are reviewed. Attempts are made to determine the relative importance of single-particle and relative diffusion for horizontal dispersion in the atmosphere. Smoke continuously released from an ideal point source is used as an example. A photograph of the corresponding instantaneous plume is compared with the statistical position of the plume described by single-particle diffusion.

33683 (ANL—76-88(Pt.4), pp 63-65) **Simple model of regional-scale precipitation scavenging of pollutants.** Sheih, C.M.; Shannon, J.D. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

An exact or even a moderately precise simulation of precipitation scavenging of pollutants on a regional scale probably will not be possible because such accuracy requires unrealistically complete knowledge of processes in cloud physics, atmospheric chemistry, atmospheric transport and diffusion, and dry deposition. Not only mean values, but also temporal and spatial variations are required. Becaue of these difficulties, we have begun the simulation of precipitation scavenging processes with a model that is simple; the model will be improved gradually as better parameterization schemes are developed and more detailed precipitation data are obtained. Some preliminary results of the simple model are presented.

33684 (ANL—76-88(Pt.4), pp 66-75) **Evaluation of precipitation scavenging rates of background aerosol.** Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

An attempt was made to obtain information on the rates at which raining clouds cleanse the atmosphere, with natural radioactivity used as a tracer of naturally-occurring aerosols. In the atmosphere, the air concentrations of the radioactive Rn daughters would be expected to approach equilibrium with increasing height. In a theoretical study, Jacobi et al. (1959) showed that the short-lived first daughter of radon (^{218}Po, 3 min half life) is in equilibrium with radon above about 20 m. Gamma-ray spectrometry was used to measure the isotopes of interest in successive samples of precipitation collected at ground level during nine rainfall occasions. Gamma-ray spectra of freshly collected rainfall were typically dominated by the photopeaks at 0.352 MeV (^{214}Pb) and 0.609 MeV(^{214}Bi). After these isotopes have decayed, the ^{212}Pb photopeak at 0.323 MeV becomes apparent (^{212}Pb is a thoron daughter). In the present work this feature was employed to allow accurate measurement of each isotope.

33685 (ANL—76-88(Pt.4), pp 76-80) **Likely effects of plant stomatal resistance on the deposition of sulfur dioxide and ozone on soybeans and maize.** Wesely, M.L.; Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

A plant canopy controls its transpiration rate primarily by regulation of stomatal aperature size, which also results in an incidental variation of the uptake rate of sulfur dioxide and ozone. However, when the concentration of either of these potentially damaging gases becomes large, the plants may react directly to the presence of the gas, in some cases causing a change in rates of tranpiration, photosynthesis, and pollutant uptake itself. In order to determine the dose in dose-response investigations, the rate at which these gases in the air are depleted by the earth's surface can be estimated by any of several techniques. These methods can be strictly aerodynamic (as are profile methods, modified Bowen ration approaches, or eddy-correlation techniques), but to understand the causes of variations in the rate of uptake, as well as distinguish between plant and soil uptake, the relationship of stomatal resistances to the vertical fluxes should also be examined. The purpose of this report is to compare briefly the importance of stomatal resistance relative to aerodynamic resistance to vertical transport of sulfur dioxide and ozone in soybeans and maize.

33686 (ANL—76-88(Pt.4), pp 81-89) **Some factors influencing dry deposition to the Great Lakes.** Hicks, B.B. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

A number of simulations of the transport of air pollutants to large lakes have been reported in recent years (e.g., Winchester and Nifong, 1971; Gatz, 1975; Sievering, 1976). The surface-flux parameterizations used in these and similar models are generally descriptions of the average behavior sometimes based on experiments that do not provide a truly representative temporal or spatial sample. Further, it appears that most of the dry deposition rates of both gases and particles are calculated using procedures that do not take into account the sometimes overpowering effects of atmospheric stability near the surface, nor do they usually permit a wind-speed dependence. Results are reported from measurements of SO_2 deposition velocities over the Great Lakes that take into account boundary layer stability, wind speed, water and air temperatures, and humidity over the largest layer of the lakes throughout a year.

33687 (ANL—76-88(Pt.4), pp 90-97) **Atmospheric dispersion over open water inferred from Lagrangian statistics.** Hart, R.L.; Frenzen, P. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

In order to measure the dispersive properties of plumes in the marine atmosphere, a series of field experiments were undertaken to obtain both Lagrangian and Eulerian turbulence statistics over open water, the intention being to use these data to construct modified plume-prediction nomograms. The experiments are based on G.I. Taylor's well-known (1921) formulation of diffusion by continuous movements. Field experiments were conducted at two locations on Lake Michigan: off-shore observations were made from a City of Chicago Water Department pumping station located on a small artificial island in Lake Michigan, and near-shore measurements were made from a water filtration plant located on the beach. Lagrangian measurements were made by tracking neutrally buoyant balloons (underinflated 30-g pilot balloons, approximately 0.5 m in diameter) that were released from a boat. The results of computer analysis of balloon trajectories analysis, together with corresponding Lagrangian standard deviations of the fluctuating wind components and dispersion coefficients indicated that with the possible exception of the case of strong instability (which occurs comparatively infrequently over water and then only when the winds are blowing away from the shore), the Lagrangian scale times appear to maintain a constant value of about 10 s for all stabilities.

33688 (BNL—50762) **Outdoor sources of indoor air pollution.** Silberstein, S. (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Nov 1977. Contract EY-76-C-02-0016. 21p. Dep. NTIS, PC A02/MF A01.

Conservation measures that seal a building, like storm window installation, can significantly reduce its energy requirements. These measures also protect its occupants from air pollutants having outdoor sources but amplify any harmful effects of those generated indoors. Using these Fourier series techniques and an approximation of outdoor pollution peaks by step functions, we obtained the following results: the average daily concentration indoors is the same as outdoors for any pollutant with no indoor sinks if inside and outside air are assumed uniform (that is, well mixed). However, lowering a building's air exchange rate 4-fold will still protect its occupants from outdoor pollution sources, but only if the outdoor peak or variation above its average is much greater than its average, and the peak is short-lived.

33689 (COO—4026-3) **Development of vertical dispersion coefficients for deep-valley terrain.** Minott, D.H.; Shearer, D.L.; Marker, R.S. (Research Corp. of New England, Wethersfield, Conn. (USA)). Sep 1977. Contract EY-76-C-02-4026. 41p. Dep. NTIS, PC A03/MF A01.

Results are reported from studies conducted to determine reliable dispersion coefficients for use with the Gaussian plume model, that will represent a broader range of topographic conditions than was intended for the standard Pasquill-Gifford values. Total-vertical-dispersion coefficients for deep-valley terrain were developed from direct measurements of vertical dispersion made by the Norwegian Defense Research Establishment (NDRE) between 1965

and 1968, in three deep valleys, and one fjord located in northern Norway. The values developed here represent mean values within stability classes and apply to continuously-emitting sources located at ground-level. The implication is that the vertical dispersion rate in a deep valley is similar to the vertical dispersion rate found at non-valley locations having similar surface topography. While this may be true for vertical dispersion, it would not be expected to hold in the case of horizontal dispersion within a deep valley. This is because the walls of a valley act, to some degree, as physical barriers to horizontal dispersion. It is recommended, threfore, that subsequent dispersion studies in deep-valley terrain be directed towards better quantification of the effects of the valley walls on the horizontal dispersion rate.

33690 (PB—272550) **Literature survey of emissions associated with emerging energy technologies.** Sickles, J.E. II; Eaton, W.C.; Ripperton, L.A.; Wright, R.S. (Research Triangle Inst., Durham, N.C. (USA)). Sep 1977. Contract EPA-68-02-2258. 77p. NTIS PC A05/MF A01.

A literature survey was conducted to address fuel contaminants and atmospheric emissions from the following energy-related operations: coal gasification, coal liquefaction, shale oil production, and petroleum refining. Sulfur and nitrogen found in coal, coal liquid product, shale oil, and petroleum crude are, for the most part, organically bound. Only coal was found to have substantial amounts of inorganic contaminants, and this was as pyrite (FeS2). The sulfur content of most fuels is less than 5% and occurs as thiols (mercaptans), sulfides, disulfides, and thiophenes. Nitrogen is usually reported at less than 2% and occurs as pyridines, pyrroles, indoles, carbazoles, and benzamides. Quantitative estimates of criteria air pollutant emissions from energy-related operations are tabulated. A broad spectrum of sulfur-containing compounds, nitrogen-containing compounds, and hydrocarbons has been identified from analyses of intermediate process streams and final products from fuel conversion processes. The surveyed literature provides a basis for identifying the major emissions. The same or similar species are expected to be emitted from each fuel conversion facility.

33691 (PB—272597) **The status of indoor air pollution research 1976. Final report on Phase 1.** (Geomet, Inc., Gaithersburg, Md. (USA)). May 1977. Contract EPA-68-02-2294. 502p. (GEOMET-EF—547). NTIS PC A22/MF A01.

Numerous research projects have examined the occurrences of air pollution in outdoor and workplace environments. A smaller, newer body of research has examined air pollution in nonworkplace, indoor environments. A new emphasis on measures to conserve energy in buildings, curbing heat loss through reduced indoor-outdoor air exchange, has encouraged interest in the relation between indoor and outdoor air quality, building energy conservation, and the potentials for adverse health effects from indoor air pollution in nonworkplace environments. A review of this body of research is the subject of this report. The preparation of this report required a comprehensive survey and assessment of the state-of-the-art of indoor air pollution research described in published literature and unpublished ongoing research.

33692 (PB—272784) **Hydrocarbon pollutants from stationary sources. Final report Dec 75—Jun 76.** Cavanaugh, E.C.; Owen, M.L.; Nelson, T.P.; Carroll, J.R.; Colley, J.D. (Radian Corp., Austin, Tex. (USA)). Sep 1977. Contract EPA-68-02-1319. 333p. NTIS PC A15/MF A01.

The report gives results of a study of hydrocarbon pollutants from stationary sources. Early in the study, readily available information was assembled on stationary sources of hydrocarbon emissions and effluents. Information was also obtained on process descriptions, operating parameters, current controls, and control problems. As the data base was assembled, the data was divided into major categories for subsequent evaluation. Pollutants from process streams were evaluated along with fugitive emissions associated with equipment leaks (e.g., from pumps, valves, and flanges). Emissions were also included from open sources (e.g., forest fires) and from natural sources (e.g., pine forests). Information in each category was divided into logical classes and grouped for further assessment of emissions and effluents from processes and operations. A list of the emission and effluent rates from the processes and operations studied is in the Appendix. Major emission and effluent sources in each category were identified and assessed as to source controllability. Specific processes and operations representing the greatest potential for the reduction of hydrocarbon emissions and effluents by the application of central technology were selected for further study.

33693 (PB—272886) **Stack tests at Kennecott Copper Corp. Hayden, Arizona smelter. Final report Aug—Dec 76.** Steiner, J.; Larkin, R. (Acurex Corp., Mountain View, Calif. (USA). Aerotherm Div.). May 1977. Contract EPA-68-01-3158. 247p. NTIS PC A11/MF A01.

In August and December 1976 at the request of EPA, Region IX, Enforcement Division, the Aerotherm Division of the Acurex Corporation conducted a series of air pollutant mass emissions tests at the Ray Mines Division copper smelter of the Kennecott Copper Corporation located in Hayden, Arizona. The tests were conducted at the reverberatory furnace stack in August 1976 and at the sulfuric acid plant stack in December 1976. Tests for particulate matter (Method 5), sulfur dioxide and sulfuric acid (Method 8) were conducted at each location using a combined sampling train. In addition two tests for condensable particulate matter were conducted at the reverberatory furnace stack using the combined Method 5 and 8 sampling train with an instack filter added. (Portions of this document are not fully legible)

33694 (UCD—472-124, pp 2-6) **Generation of respirable aerosols of power plant fly ash for inhalation exposure of experimental animals.** Raabe, O.G.; McFarland, D.; Tarkington, B.; Teague, S.; Prentice, B. Oct 1977.

In Annual report, fiscal year 1977.

Equipment has been designed and built for generating and characterizing fly ash aerosols that simulate the respirable particles in effluents from coal-burning power plants. Currently acute exposures are being conducted with size-separated respirable particles collected directly from the stack of a western power plant. Fly ash from the hopper of an electrostatic precipitator is being used in chronic exposures.

33695 (UCD—472-124, pp 6-9) **General method for fitting size distributions to multicomponent aerosol data using weighted least-squares.** Raabe, O.G. Oct 1977.

In Annual report, fiscal year 1977.

In our work with biomedically important aerosols released to the environment by various energy technologies, size classified particles are collected with instruments, such as cascade impactors, cyclones, diffusion batteries, and a spiral duct aerosol centrifuge. Also data are collected with light scattering particle counters, Coulter counter, and by electron and light microscopy. A general and straightforward method has been developed for fitting a chosen mathematical function (probability density) to such grouped data. In this method the collection efficiency characteristics of each data component or sampler stage are used to fit the probability density function by non-linear least-squares regression analysis, with each datum weighed by the reciprocal of its estimated variance. The actual collection efficiencies with respect to particle size may be used instead of effective or average values even if these actual efficiencies cannot be expressed as explicit functions. Particle size may be geometric, aerodynamic, or whatever size convention is measured by the sampling device. Estimates are made of the confidence limits of the fitted parameters, and the correlation coefficient and chi-square values are used to test the acceptability of the chosen mathematical function.

33696 (UCD—472-124, pp 10-13) **Aerosolization of bulk powders utilizing fluidized-bed and Wright dust feed techniques.** McFarland, A.R.; Ortiz, C.; Fisher, G.L.; Raabe, O.G. Oct 1977.

In Annual report, fiscal year 1977.

The operating characteristics of the Wright dust feed and an experimental fluidized-bed aerosol generator have been compared for the generation of respirable aerosols from dry powders of power plant fly ash, Arizona road dust, and Ottawa silica. The Wright dust feed mechanism was superior to the fluidized-bed generator in deagglomeration of particles. Although similar aerosol mass concentrations were achieved with the two devices, the Wright dust feed consistently provided aerosols with smaller mass median aerodynamic diameters. The Wright dust feed appears to be the preferred aerosol generator for inhalation exposure experiments.

33697 (UCD—472-124, pp 14-20) **Morphological studies of coal fly ash.** Fisher, G.L.; Prentice, B.A.; Silberman, D. Oct 1977.

In Annual report, fiscal year 1977.

On the basis of a previously described morphogenesis scheme for coal fly ash, the relative abundance of morphological particle types was determined for four size fractions of fly ash collected from a power plant stack. The proportion of cenospheres was directly related to particle size whereas the proportion of non-opaque solid spheres was inversely related to particle size. In addition, the particle size distributions of coal fly ash were compared to isokinetic stack sampling data obtained by Lawrence Livermore Laboratory at the same power plant.

33698 (UCD—472-124, pp 21-23) **Analysis of asbestiform minerals by thermoluminescence.** Fisher, G.L.; Bradley, E.W.; Draftz, R.G. Oct 1977.

In Annual report, fiscal year 1977.

A new, rapid and inexpensive method for the qualitative analysis of asbestiform minerals has been developed using existing thermoluminescent technology. A combination of thermoluminescence before and after ^{60}Co irradiation provided a singular identification of the individual minerals.

33699 (UCD—472-124, pp 61-62) **Effect of trace elements in fly ash on concanavalin A stimulation of canine lymphocytes.** Shifrine, M.; Fisher, G.L.; DeRock, E.W.; Taylor, N.J.; Wiger, N. Oct 1977. In Annual report, fiscal year 1977.

Trace element concentrations were calculated to approximate concentrations that would be found in a macrophage that had phagocytized 10 or 1 fly ash particle with the properties of our finest fly ash fraction (VMD = 2.2 μm, sigma/sub g/ = 1.8). These concentrations were produced by 1:100 and 1:1000 dilutions of stock solutions in tissue culture media. Results of CON A stimulation of lymphocytes with and without additions of trace elements were compared. Although most of the elements inhibited lymphocyte stimulation to some degree, selenium was stimulatory at the lower concentration and antimony had no effect. Vanadium produced complete inhibition in this system at both concentrations. Subsequent tests with serial dilutions of vanadium stock solution showed that a dilution of 1:3000 was necessary to produce a 37 percent inhibition (D_{37}).

33700 **Processes limiting oxidation of sulfur dioxide in stack plumes.** Schwartz, S.E.; Newman, L. (Brookhaven National Lab., Upton, NY). *Environ. Sci. Technol.;* **12**: No. 1, 67-73(Jan 1978).

A formalism is developed to treat chemical reactions in expanding stack plumes of arbitrary concentration profile to examine the effects of dilution and of oxidant or catalyst depletion upon SO_2 oxidation. The rate and extent of reaction are described in terms of an assumed mechanism and defined measurable properties of the concentration profile. The rate of plume expansion exerts a controlling influence upon reactions that are higher than first order in plume constituents. Quenching of reaction is exhibited at high expansion rates. For the concentration of a conservative tracer diminishing with time proportionately to t/sup -n/, a pth-order reaction is quenched for n(p - 1) > 1 and unquenched for n(p - 1) less than or equal to 1. The meteorological stability classes that would lead to quenching of second- and third-order reactions are considered. Reexamination of SO_2 oxidation data obtained in studies of the Northport, NY, oil-fired plume confirms that the oxidation mechanism is higher than first order and strongly suggests second order. The data are consistent with this mechanism for a wide range of assumed catalyst/SO_2 ratios; it is thus established that no inference may be drawn concerning catalyst depletion. The implications of these new insights are considered relative to the design of plume experiments and to the understanding of SO_2 oxidation mechanisms in plumes and in the ambient atmosphere.

33701 **Photochemical reactions among formaldehyde, chlorine, and nitrogen dioxide in air.** Hanst, P.L.; Gay, B.W. Jr. (Environmental Protection Agency, Research Triangle Park, NC). *Environ. Sci. Technol.;* **11**: No. 12, 1105-1109(Nov 1977).

Photochemical reactions among chlorine, nitrogen dioxide, and formaldehyde were studied, using parts-per-million concentrations in 1 atm of air. The reactant mixtures were irradiated by ultraviolet fluorescent lamps and simultaneously analyzed by the Fourier transform infrared technique by use of folded light paths up to 504 m. With an excess of NO_2 over Cl_2, the reaction products included O_3, CO, HNO_3,N_2O_5, HCl, and nitryl chloride ($ClNO_2$). When chlorine exceeded NO_2, the principal product was peroxy nitric acid ($HOONO_2$). Peroxy formyl nitrate, nitrous acid, and chlorine nitrate were not seen. The nitryl chloride was stable even with the ultraviolet lights on. The peroxy nitric acid disappeared from the cell with a half-life of about 10 min. Formyl radicals (HCO), unlike acetyl radicals, did not combine with O_2 and NO_2 by addition. HCO reacted with O_2 to yield CO and HO_2. The HO_2 will then add to NO_2 to yield $HOONO_2$. If NO is present, the HO_2 will prefer to react with it, oxidizing it to NO_2.

33702 **Sorptive behavior of trace metals on fly ash in aqueous systems.** Theis, T.L.; Wirth, J.L. (Univ. of Notre Dame, IN). *Environ. Sci. Technol.;* **11**: No. 12, 1096-1100(Nov 1977).

Eleven different fly ashes from coal-fired power plants were subjected to various chemical extractions and washings for determination of their acid-base and heavy metal chemistry. Results suggested that the relative amounts of lime and amorphous iron oxides on the surface define the ultimate acidic or basic character of fly ash in solution. In spite of wide variations in heavy metal content, most metals displayed an association with a specific surface oxide of either iron, manganese, or aluminum. Desorption of metals in aqueous solution followed a predictable pattern of decreasing release with increasing pH. Arsenic was an exception to this at high pH. Mercury behaved anomalously due to the presence of the elemental form. Ranges in reported values are attributed primarily to the variable geochemical matrix in which the heavy metals are found before mining.

33703 **Inteferences in chemiluminescent measurement of NO and NO_2 emissions from combustion systems.** Matthews, R.D.; Sawyer, R.F.; Schefer, R.W. (Univ. of California, Berkeley). *Environ. Sci. Technol.;* **11**: No. 12, 1092-1096(Nov 1977).

Two factors that may affect the quantification of NO and NO_2 concentrations when using chemiluminescent analysis are investigated. The first is the dependence of the chemiluminescent intensity on competing third body quenching reactions. Relative quenching efficiencies are determined as a function of third body concentration for six different species that are common products of combustion. A mathematical expression is derived that allows calculation of the actual concentration of NO, given the indicated concentration of NO and the concentrations of the important third bodies. An example calculation is presented. The second factor investigated involves the conversion to NO of low molecular weight nitrogen-containing species, other than NO_2, in commercial NO/sub x/ converters. Conversion efficiencies for six species are determined using a commercial stainless steel catalyst at 920 K.

33704 **Modeling carbon monoxide dispersion from roadways.** Maldonado, C.; Bullin, J.A. (Texas A and M Univ., College Station). *Environ. Sci. Technol.;* **11**: No. 12, 1071-1076(Nov 1977).

The dispersion of a nonreactive gas from roadways is modeled by using a combination of empirical data fitting and gradient transport-type diffusion. The pollutant concentration at the edge of the roadway is predicted by an empirical equation while the concentration downwind off the roadway is predicted by a gaussian dispersion model. The surface roughness of the site, the mean wind velocity profile, and the variation of eddy diffusivity are considered in the model. Predictions from the present model along with those from the previous models, CALINE-2, AIRPOL-4, and HIWAY are compared with data from five experimental programs. This is the largest data base on dispersion from roadways assembled to date and the first extensive comparison of previous models. The present model is a significant improvement over the previous models. The relative computation time was 0.01 s/case compared to 0.09, 0.14, and 0.48 s/case for CALINE-2, AIRPOL-4, and HIWAY, respectively.

33705 **Polycyclic aromatic hydrocarbons in soils of a mountain valley: correlation with highway traffic and cancer incidence.** Blumer, M. (Woods Hole Oceanographic Inst., MA); Blumer, W.; Reich, T. *Environ. Sci. Technol.;* **11**: No. 12, 1082-1084(Nov 1977).

Analyses of soils in the vicinity of a Swiss mountain town show a correlation between the content of polycyclic aromatic hydrocarbons (PAH) and the proximity to a highway. PAH contents range from 300 mg/kg dry soil near the highway to 4-8 mg/kg in the surrounding higher alps. The PAH composition ranges from three- to eight-membered rings and to heavily alkyl-substituted derivatives. The PAH mixtures are far more complex than was assumed in the past and resemble that of automobile exhaust. The low values in town close to industry but remote from the highway, and high PAH values outside of town but near the highway suggest a correlation between automobile traffic and PAH content of soils. These results indirectly suggest also a correlation between the automobile traffic and the observed mortality from cancer in this area.

33706 **Technique for determining probability distributions for creation and destruction of ozone and other tracer particles.** Houseman, G.; Martin, B. (Sydney Univ., Australia). *Tellus;* **29**: No. 5, 455-461(Oct 1977).

A numerical technique is presented for calculating where, on average, tracer particles at a particular place in a turbulent medium were created, and where they will be destroyed. This technique requires knowledge of creation, destruction, and transport rates, and gives as results probability distributions for creation and destruction. The technique is demonstrated on a model of stratospheric ozone, and a rough quantification is made of the statement that high latitude, low altitude ozone tends to be created in low latitude, high altitude regions.

33707 **Nuclepore membrane filters: 10 years of application in dust and aerosol measurement.** Spurny, K. *Staub-Reinhalt. Luft;* **37**: No. 9, 328-334(Sep 1977). (In German).

Thin, fine porous analytical ultrafilters made of polycarbonate sheets are commercially available as Nucleopore membrane filters for more than 10 years. Their physical properties as well as many application possibilities in the field of dust and aerosol sampling and measurement are described. These filters are also very suitable for determination of particle mass and particle number concentrations, for particle size measurements, for microscopic analysis, for microchemical analysis by means of neutron activation and X-ray fluorescence methods, etc.

33708 **Results of comparative measurements with three dust-sampling instruments in ambient air.** Friedrichs, K.H.; Grover, Y.P. *Staub-Reinhalt. Luft;* **37**: No. 9, 338-341(Sep 1977). (In German).

In a comparison program three dust sampling instruments (BAT I, TBF 50f and Gravikon VC 25) were used in ambient air. In spite of different characteristics of the pre-separators the results of respirable dust concentration were found to be in the same range. There is no complete agreement between separation characteristics of the instruments and the recommendations given by 'TA Luft' and

'VDI-Richtlinie 2310'. On the other hand comparison between American measuring programs and this type of measurements should be possible, because of the similar type of the pre-separators.

33709 Correlation between SO_2 measurements and meteorological parameters on a pole 200 m high. Ahrens, D.; Nester, K. *Staub-Reinhalt. Luft;* **37**: No. 8, 307-313(Aug 1977). (In German).

Measurements of SO_2 at a height of 20, 100 and 200 m above ground level are reported,, and their correlation with meteorological parameters is discussed. The investigation has been undertaken separately for summer and winter. For all heights the SO_2 immission is correlated with the direction of wind. At the highest point of measurement the relationship between the immision and the individual groups of emitting sources, and also such parameters as wind velocity, temperature increase and vertical changes in wind direction, is investigated. It has been found that, in addition to the height and distance of the emitting source, plant life growing on the ground is an important factor influencing the emission structure.

33710 Studying the particle-size distribution of atmospheric dust near the ground. Laskus, L. *Staub-Reinhalt. Luft;* **37**: No. 8, 299-306(Aug 1977). (In German).

Particle size analyses of atmospheric particulates were performed with multiple stage Andersen impactors at measuring sites in seven German cities. The results indicate that 86 to 90% (mean 88%) of total particulates lie within a particle size range of 10 μm and below irrespective of the site of measurement and varying concentration of total particulates. The respirable and thus hygienically most important proportion of fine particulates (size range: 5 μm and below) constituted 79% (mean vlue) of total particulates. In both cases, there was only a small range of variation. Comparative measurements using a single-step filter cyclone and various other instruments measuring total particulate concentration were performed in parallel to the above mentioned investigations. The retention of the particles by the different methods tested were compared and their correlation determined. The Staplex filter method (high volume air sampler) proved to be particularly reliable when variations of wind speed were considered. However, this apparatus, like the other instruments, did not record the total particulate content as separation effects occur at the suction aperture due to external movements of air. Compared to the results from this instrument, the precipitation efficiency of the TBF-filter cyclone was inadequate.

33711 Gaseous emissions of motor vehicles and gaseous pollutant concentrations on streets under variable conditions. Deuber, A. *Staub-Reinhalt. Luft;* **37**: No. 7, 251-257(Jul 1977). (In German).

A simple formula for the calculation of gaseous pollutant concentrations on streets is developed. The data used are: number, speed, presence, time, length and emission rates of vehicles and average wind velocity. A comparison between 161 calculated and measured CO concentrations gave an average agreement of +-5%. The calculation procedure could be applied without alteration on very different situations of building density, traffic and atmospheric conditions. By the same method not only CO but also hydrocarbons and, within certain limits, NOsub(x) levels could be calculated.

33712 Immission prognoses: comparison of different methods. Willner, L. *Staub-Reinhalt. Luft;* **37**: No. 7, 260-266(Jul 1977). (In German).

The assumptions needed to solve the partial differential equation for the dispersion of effluents in air are listed. Based on these assumptions, the solution of the equation due to Pasquill/Wippermann is stated, being one of today's most widely used methods for predicting the dispersion of effluents in air. The determination of parameters required for calculating the dispersion is illustrated by methods described in the draft of the VDI-Richtlinien 2289, part 1, Sept. 1974. A comparison of five different prediction procedures outlines the different ways of determining the meteorological stability classes and the methods for calculating the diffusion coefficients, the effective source height, and the effective wind velocity. A numberical example illustrates the differences in the prediction results.

33713 Effect of different types of glass filters on total suspended particulates and their chemical composition. Witz, S.; MacPhee, R.D. *J. Air Pollut. Control Assoc.;* **27**: No. 3, 239-241(Mar 1977).

Atmospheric particulates, collected on four different types of filters (Gelman A, AE, Spectro Grade, and a special batch of Type A supplied by the EPA) in a side-by-side comparison showed differences in total suspended particulates (TSP) and lead loading as high as 20 and 17 percent, respectively (using Gelman A as a reference). The differences in sulfate and nitrate were even greater, running as high as 49 and 219 percent, respectively. Catalytic conversion of SO_2 and NO_2 to particulate sulfate and nitrate on contact with the filter surface is believed responsible for the anomalously high values observed. For all of these parameters (i.e., TSP, lead, sulfate, and nitrate) Gelman's Spectro Grade and AE filters yielded the highest values and Gelman Type A the lowest. Based on these results and assuming that catalytic conversion produces erroneously high data, one might be inclined to conclude that Type A was superior to the others; however, additional studies on collection efficiencies and interaction effects with filter constituents would be required before such a conclusion would be warranted. The results do indicate that the type of filter medium used in hi-vol sampling has a pronounced effect on the results. It therefore becomes imperative that all agencies involved in air monitoring surveillance standardize on a single filter medium as soon as possible. This priority becomes even more urgent in view of the 25 $\mu g/m^3$ sulfate standard recently imposed by the California Air Resources Board. The long-range goal should be the development of a filter for which the catalytic conversions are either eliminated or at least held to a minimum (i.e., 5 percent or less).

33714 Estimates of errors in anisokinetic sampling of particulate matter. Selden, M.G. Jr. (Pollution Measurement Corp., Chicago). *J. Air Pollut. Control Assoc.;* **27**: No. 3, 235-236(Mar 1977).

The mass concentration of particulate matter suspended in a flowing gas stream (stack gas) is commonly measured by aspirating samples of the particle-laden gas into a nozzle (aligned to have its suction orifice facing the flow). The mass concentration (e.g., grains per standard cubic foot of gas) is normally computed from the ratio of the mass of particles collected to the volume of gas sampled. The mass concentration will be correctly computed, provided that precautions are taken not to alter the samples. A major precaution is to assure negligible sampling bias by isokinetic sampling with proper alignment of a sharp edged sampling nozzle. When the mean aspiration velocity differs from the upstream gas velocity (anisokinetic sampling), the gas flow is disturbed, causing a change in particulate matter concentration within the gas entering the sampling nozzle. The error in particulate matter concentration, as a result of anisokinetic sampling, is a function of the particle sizes, nozzle diameter, particle density, gas density, the sampling speed, the speed of the upstream flow, and the viscosity of the gas (eight independent variables).

33715 Measuring and testing procedures for motor vehicle exhaust emissions: a survey and a critique. Klingenberg, H. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.). Hauptabteilung Messtechnik-Forschung). *Arch. Tech. Mess. Messtech. Prax.;* **44**: No. 2, 53-60(Feb 1977). (In German).

The regulated European and US test methods and measuring procedures for the limitation of exhaust emissions and for fuel consumption of vehicles with combustion engines are described and discussed. The analysis of the exhaust emissions concerning the limited gas components hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOsub(X)) is performed with gas analyzers, of which the operating principles are illustrated. Test and measuring procedures for not yet limited exhaust components (sulfates, aldehydes etc.) are also described. As a matter of fact, all test results are subject to considerable variability due to measuring uncertainties and to scatter of the mass emission of the vehicle. Single measured values are therefore almost useless; only the mean of many measured values is representative for the 'true' exhaust emission of a vehicle. Up to now this fact has practically not been considered in the regulations. Results of a probability analysis for passing the legally prescribed exhaust emission certification tests are presented. Based on these results, proposals for better test procedures are deduced and discussed.

33716 Measuring and testing procedures for motor vehicle exhaust emissions: a survey and a critique. Klingenberg, H. (Volkswagenwerk A.G., Wolfsburg (Germany, F.R.). Hauptabteilung Messtechnik-Forschung). *Arch. Tech. Mess. Messtech. Prax.;* **44**: No. 1, 3-14(Jan 1977). (In German).

The regulated European and US test methods and measuring procedures for the limitation of exhaust emissions and for fuel consumption of vehicles with combustion engines are described and discussed. The analysis of the exhaust emissions concerning the limited gas components hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOsub(x)) is performed with gas analyzers, of which the operating principles are illustrated. Test and measuring procedures for not yet limited exhaust components (sulfates, aldehydes etc.) are also described. As a matter of fact, all test results are subject to considerable variability due to measuring uncertainties and to scatter of the mass emission of the vehicle. Single measured values are therefore almost useless; only the mean of many measured values is representative for the 'true' exhaust emission of a vehicle. Up to now this fact has practically not been considered in the regulations. Results of a probability analysis for passing the legally prescribed exhaust emission certification tests are presented. Based on these results, proposals for better test procedures are deduced and discussed.

33717 Turbulence and stability estimates in atmospheric dispersion modeling. Wang, I.T.; Dufner, K.L. (Rockwell International, Creve Coeur, MO). pp 51-55 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).
See CONF-770438—P1.

It is pointed out that significant improvement on the accuracy of conventional dispersion model predictions can be realized by introducing a more effective turbulence and stability estimating scheme based upon routinely measured surface wind speed and vertical differential temperature. A systematic test of the new scheme is carried out using turbulence and heat flux data collected in St. Louis and elsewhere.

33718 Analysis of predicted short- and long-term concentrations of SO_2 in a restricted-valley situation. Yang, K.G.; Star, A.M.; Solomon, A.L. (Bureau of Air Quality and Noise Control, Baltimore). pp 719-724 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).
See CONF-770438—P2.

Distributions of SO_2 in Cumberland, Maryland are simulated by using an extensively modified version of the EPA rough terrain Valley model. Major changes include both improved assumptions on plume behavior in complex terrain and a listing of maximum 1-hour concentrations at each receptor point along with the related meteorological variables (source contribution table). An analysis of the SO_2 concentrations show violations only of the short term standard, this during the stable, impaction case.

33719 Accurate simulation of environmental impact over large regions. Newkirk, R.T. (Univ. of Waterloo, Canada). pp 781-785 of Modeling and simulation. Volume 8, Part 2. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).
See CONF-770438—P2.

Planning optimal locations for major energy-transmission, communications, and processing facilities requires accurate simulation of potential environmental impact over large areas. A generalized simulation system which performs this task is described. A major difficulty resolved is accurate determination of a discrete-valued impact surface over regions with area in excess of 2,000 square miles. An extensive data base is defined and developed. The data base and a set of problem-oriented orthogonal impact factors determine the multicomponent discrete-valued impact surface. An important feature of the simulation is an algorithm to combine multiple ordinal-valued orthogonal factor ratings, taking into account cumulative threshold conditions. Automatic alternate-route selection is performed, and estimated associated impacts presented by both tabular output and computer-generated maps.

33720 Automobile traffic and air pollution in a developing country (an example of affluence-caused environmental problem). Oluwande, P.A. (Univ. of Ibadon, Nigeria). *Int. J. Environ. Stud.;* **11**: No. 3, 197-203(1977).

This paper reports the results obtained from a study carried out, over a period of one year, to determine the levels of air pollutants in urban and rural areas of parts of Nigeria. Originally, five types of pollutants (dust, SO_2, CO, Pb and NO/sub x/ SO_2 were scheduled to be monitored, but because of difficulty in obtaining equipment only SO_2, CO and dust are monitored. Results of the study show that automobile exhaust emission is the main source of air pollutants. The levels in urban areas are higher than WHO long term limits, while the levels in rural areas are still very low. The concentrations are highest at the road sides, where many people stay daily from morning till evening to work and sell their wares. In order to obtain a long-term picture of the problem, the research is expected to continue for many years.

33721 Air pollution measurements in a semi-arid zine, using neutron activation analysis. Shani, G.; Cohen, D. (Benn-Gurion Univ., Beer-Sheva, Israel). *Tellus;* **29**: 535-544(1977).

Neutron activation analysis was used for measurement of air pollution in a semi arid zone. After a careful selection of the air filter, air samples were filtered in the city of Beer-Sheva in the south of Israel. The sampling took place over a period of 2 months with each sampling period lasting 2 days. The samples were irradiated in a thermal neutron flux of the order of 10^{13} n/cm^2 sec for 1 h and the gamma spectrum was measured several times. The concentration of elements was concluded from the measured gamma spectrum. Several conclusions were obtained by combining the weather conditions with the measurement results. The air pollution can be divided into several sources: dust of a certain origin containing Fe, Co, Cr, Sc, Th and Na (probably from the Dead Sea area), other dust sources containing Sb, Eu, and Hf, and urban pollution due to industry and transportation—Br, Hg. The air pollution has its maxima and minima according to weather or industrial conditions. The pollution requires 4 days to clear out. Other relations to weather conditions were also found.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33634, 33684

33722 (PNCT—831-75-02, pp 200-206) **Monitoring station at Tokai Works, PNC.** Matsumoto, M.; Muto, S.; Kuwana, K.; Kurabayashi, M.; Kinoshita, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1975.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jan—Jun 1975.

The environmental monitoring prior to the operation of the Reprocessing plant at Tokai is being carried out. The exposure rate at ground level and the dust concentration in air are measured at some permanently fixed points. The detectors used for the monitoring are a NaI(Tl) scintillator for the exposure measurement and four Geiger—Mueller counters for the beta counting. The monitoring stations are located at three areas. For the normal release of radioactivity from the Reprocessing Plant, the yearly average concentration of Kr-85 can not be measured at the stations, but can be obtained by using stack monitor data, meteorogical data, and theoretical diffusion equations. The environmental field gamma exposure rates are measured continuously at the stations and at five monitoring posts. The accumulated exposure doses for three months were monitored with thermoluminescent dosimeters. The stations are checked once a week to maintain their normal operation and to collect one-week samples of dust and iodine.

33723 (STH—6/75) **Compilations of nuclides determined by examination of aerosol and iodine filter samples from the exhaust air control system of the nuclear power plants Gundremmingen, Obrigheim, Wuergassen, Stade, Lingen and Biblis in 1974.** Winkelmann, I.; Endrulat, H.J.; Riedel, H. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Oct 1975. 6p. (In German). Dep. NTIS (US Sales Only), PC A02/MF A01.

The report at hand is a compilation of data on individual nuclides gained by gamma spectrometry measurements of the aerosol and iodine filter samples from the exhaust air control system of the nuclear power plants Gundremmingen, Obrigheim, Wuergassen, Stade, Lingen and Biblis. These data were made use of for the calculation of the radiation exposure from nuclear facilities in the report on environmental radioactivity and radiation exposure in 1974 which went to the Bundestag.

THERMAL EFFLUENTS MONITORING AND TRANSPORT

33724 (ANL—76-88(Pt.4), pp 104-107) **New cooling-pond fog index.** Hicks, B.B.; Shannon, J.D. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

An improved measure of the tendency for steam fog to occur above industrial cooling ponds has been developed. The new index is based on the premise that air immediately above a heated water surface is strongly buoyant and that air in rising thermal plumes is replaced by air from above the layer in equilibrium with the surface. This would then give rise to an air layer whose characteristic temperature is approximately T/sub c/ = $\frac{1}{2}$ (T/sub s/ + T/sub a/) and whose humidity is about e/sub c/ = $\frac{1}{2}$ (e/sub s/ + e/sub a/), where the subscripts s and a indicate values for the surface and for the ambient air, respectively. Then the air near the surface will be supersaturated if the saturated vapor pressure e'/sub c/ at temperature T/sub c/ is less than e/sub c/. The excess vapor pressure (e/sub c/ - e'/sub c/) has been termed the Fog Excess Water Index (FEWI).

33725 (ANL—76-88(Pt.4), pp 108-113) **Winterfield program at the Dresden cooling ponds.** Everett, R.G.; Zerbe, G.A. 1976.

In Radiological and Environmental Research Division annual report. Atmospheric physics, January—December 1976.

A winter field program at the cooling ponds of the Dresden nuclear power plant began in November 1976. Data for the initial season are still being analyzed, but some interesting phenomena and the problems encountered in data collection are reported. The program at Dresden consists of gathering data, including a description of the fog or stratus conditions over the cooling pond complex. Photographic observations are taken each morning and evening. Other data collected for the fog-occurrence model are water temperature and the upwind ambient air temperature and relative humidity. The extent of the fog and stratus conditions associated with the cooling ponds varied from day to day, but almost always there was fog covering at least Pond 1 to a depth of 2 to 20 m or more. The fog often extended downwind several hundred meters, causing extensive rime icing on trees, fences, and poles. On some of the clear, cold days, a sharply defined stratus layer, clearly visible from a 10

km distance, formed over the pond and extended several kilometers downwind of the pond complex. Some commonly observed phenomena were vertical plumes of heights up to several hundred meters. At times stratocumulus clouds formed from the larger plumes. On two occasions, thermal vortices or steam devils were observed.

33726 (CONF-770151—10) **Drift data from a large natural draft brackish water cooling tower and brackish water particulate scrubber.** Webb, R.O.; Schrecker, G.O.; Guild, D.A. (Environmental Systems Corp., Knoxville, Tenn. (USA)). 1977. Contract EW-78-X-05-0731. 24p. Dep. NTIS, PC A02/MF A01.

From Meeting of the cooling tower institute; Houston, TX, USA (31 Jan 1977).

Drift data are presented which were acquired in PEPCO's Chalk Point Unit No. 3 fossil-fuel power plant natural draft cooling tower and Unit No. 3 scrubber stack at Aquasco, Maryland. Source data in the form of droplet size spectra and salt mass emission were acquired via an equal area traverse near the exit plane of the 400 foot tower and at the 420 foot level of the 712 foot stack. Results show that the drift fraction of the tower is within the manufacturer's guarantee when the tower circulating water flow rate is assumed to be the design value (260,000 gpm). Droplet spectra show that at least 83% of the tower drift mass emission is represented in droplets less than 240 micrometers in diameter. Results show further that the sodium mass emission and drift droplet mass median diameter of the stack are comparable to those from the cooling tower.

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 32975

REGULATIONS

33727 (AD—045316) **Survey of army mobile power plant pollution requirements. Final report.** Newman, F.M. (Southwest Research Inst., San Antonio, Tex. (USA). Army Fuels and Lubricants Research Lab.). Aug 1977. Contract DAAG53-76-C-0003. 8p. (AFLRL—93). NTIS PC A02/MF A01.

This report reviews and summarizes the past work that has been done by the Army to relate emissions to fuel composition, the hardware performance factors, the emissions regualtions as they vary from state to state, the relation of those regulations to Army operations and the areas where additional action is warranted. (Author)

33728 International regulation of chlorofluoromethanes. Stoel, T.B. Jr.; Compton, R.I.; Gibbons, S.M. (Natural Resources Defense Council, Washington, DC). *Environ. Policy Law;* **3**: No. 3/4, 129-132(Dec 1977).

The hazards of chlorofluoromethanes (CFM) released by aerosol sprays, refrigeration equipment, and other industrial processes are examined on the basis of cost benefit analysis and the conclusion reached that international action to limit the use of CFM is warranted. Uncertainty remains as to how much danger is involved and how it is manifested. The problem of effective regulation by individual governments in light of these uncertainties may need to be handled by political consensus and by pressures brought on suppliers. CFM's are believed to damage stratospheric ozone when they are broken down by ultraviolet radiation and release chlorine. It is thought that deterioration of the ozone layer may cause crop and soil damage, increase the risk of skin cancer, and modify weather. A Federal task force on Inadvertent Modification of The Stratosphere, (IMOS), supported by findings of The National Academy of Sciences and The National Aeronautic and Space Administration, determined that there is sufficient cause to restrict the use of CFM to closed systems. 8 references.

33729 Federal act on protection against nuisances from the view of the operators of boiler plants in power stations and industrial plants. Schmidt, G. (Gesamtverband des Deutschen Steinkohlenbergbaus, Essen (Germany, F.R.)). *Energie;* **29**: No. 7, 232-233(Jul 1977). (In German).

Nobody knows for certain what is needed to meet the requirements of the Federal Act on the protection against nuisances with regard to power stations. What is all right for Hamburg need not be sufficient for Essen. Courts decide locally differently, and the construction on the planned power station Voerde, for instance, has not begun because of existing legal uncertainties. Immission values are still not consolidated.

33730 Legal regulations of some countries concerning clean air. *Arch. Energiewirtsch.;* **31**: No. 7, 642-649(Jul 1977). (In German).

The development and status of legal regulations concerning clean air are outlined for a number of countries. The maximum permissible concentrations of ash, SO_2, and NO in air according to the regulations of these countries are listed in tables. For the USA, maximum permissible SO_2 emissions are given for nuclear power plants. According to this, the limiting value for SO_2 emissions is 1.4 kg/Gcal for oil-fired power plants and 2.2 kg/Gcal for coal-fired power plants. For NO, the values are 0.35 kg/Gcal for gas combustion products, 0.54 for oil combustion products, and 1.26 for coal combustion products. The limiting value for ash emissions is 0.18 kg/Gcal, and the opaque factor of the flue gases should not exceed 20%.

33731 Air pollution control philosophies. de Nevers, N. *J. Air Pollut. Control Assoc.;* **27**: No. 3, 197-205(Mar 1977).

Most air pollution control programs rest on one or more of the following four basic philosophies: emission standards, air quality standards, emission taxes, and cost benefit analysis. Frequently they rest on mixtures or combinations of these four. From 1863 to 1965 air pollution control efforts were largely based on the emission standards or "cleanest possible air" philosophy. From 1965 to the present, the air quality standards or "zero damage" philosophy has found increasing application and become the dominant philosophy in U.S. air pollution law. The emission tax or "market allocation of public resources" philosophy has been proposed and discussed as an alternative to these two philosophies. The air quality standards philosophy answers the question, "How clean should the air be," but bases the answer on an unproven assumption. The other two philosophies do not answer it at all. If the basic assumption of the air quality standards philosophy proves false, then none of these philosophies will answer that question. Informally, or unconsciously, pollution control agencies have answered the question by some kind of estimates of costs and benefits. In the future, the author suggests that this kind of analysis should be removed from the guesswork and "engineering judgment" of pollution control officers and become a formal, publicly debated part of our air pollution regulation-setting procedure.

33732 Measurement and the law: monitoring for compliance with the clean air amendments of 1970. Blacker, S.M.; Ott, W.R.; Stanley, T.W. (Environmental Protection Agency, Washington, DC). *Int. J. Environ. Stud.;* **11**: No. 3, 169-185(1977).

The Clean Air Amendments of 1970 (P.L. 91-604) contain a large number of regulatory approaches designed to operate separately and in combination to improve air quality, thereby protecting the Nation's public health and welfare. These approaches include attainment of National Ambient Air Quality Standards (NAAQS) through State Implementation Plans, control of stationary sources, and control of mobile sources. The paper discusses the essential provisions in each regulatory approach so one can appreciate its underlying purpose and the rationale for the Environmental Protection Agency's (EPA) regulatory actions in each area. Air monitoring constitutes one of the most important yardsticks available for judging the effectiveness of regulatory approaches. The paper focuses on one regulatory approach--control of air pollution through State Implementation Plans--depicting it as a feedback control system. The NAAQS are inputs to the system, the Plans are the control mechanism, and air monitoring is the "feedback loop" by which to gauge compliance with the NAAQS. Within the feedback loop are six component subsystems: monitoring site selection, sampling frequency, measurement methods, reference materials, data acquisition, and data analysis and presentation. The paper briefly describes the general operations and scientific requirements of each subsystem.

ENVIRONMENTAL SCIENCES, TERRESTRIAL

BASIC STUDIES

REFER ALSO TO CITATION(S) 33675

33733 (ORNL/TM—6205) **Discriminant analysis of some east Tennessee forest herb niches. Environmental Sciences Division Publication No. 752.** Mann, L.K.; Shugart, H.H.; Kitchings, J.T. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 116p. Dep. NTIS, PC A06/MF A01.

Thesis. Submitted by L.K. Mann to Univ. of Tennessee, Knoxville. Portions of document are illegible.

The purpose of this study was to evaluate the effectiveness of using discriminant analysis in assessing plant niches. As a component of research by the Environmental Research Park Project at Oak Ridge, Tennessee, five sites were inventoried for herbaceous species. From this inventory, four sympatric species of Galium and seventeen co-occurring herbaceous species were selected for discriminant analysis. The four species of Galium were treated as two data sets: one was composed of information collected at one site (a mesic hardwood area) and the other contained data from two cedar sites of

shallow soil over limestone bedrock. The seventeen herbaceous species all occurred in the mesic hardwood area.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 32602, 33302

33734 Abiological methylation of mercury in soil. Rogers, R.D. *J. Environ. Qual.;* **6**: No. 4, 463-467(1977).

The results from this work define several factors influencing the methylation of mercuric ion in soil. Two of the most important findings were that it is possible to extract the mercury methylating factor from soil with a solution of 0.5N sodium hydroxide (NaOH) and that this factor is responsible for the abiological methylation of Hg in the soils under investigation. The ability of the soil extract to methylate Hg is influenced by temperature, mercuric ion concentrations, and solution pH. In addition, it was found that the methylating ability of the soil extract was stable at high temperatures (121C), but was lost after exposure to ultraviolet radiation. When the 0.5N NaOH extract of soil was separated into a soluble fraction and an insoluble precipitate, the ability to methylate mercuric ion remained with the soluble fraction. It was found that the methylating factor was lost when the 0.5N NaOH extract was dialyzed against distilled water. Other work showed that the methylating factor passes through dialysis tubing into the distilled water.

33735 Gas chromatographic analysis of soil atmospheres. Blackmer, A.M.; Bremner, J.M. (Iowa State Univ., Ames). *Soil Sci. Soc. Am. J.;* **41**: No. 5, 908-912(1977).

A gas chromatographic procedure is described that permits rapid, specific, and precise determination of N_2, O_2, Ar, CO_2, CH_4, N_2O, and other gases in soil atmospheres. It involves use of an ultrasonic detector and two columns of Porapak Q at different temperatures, and it does not require temperature programming, column conditioning, stream splitting, column switching, or switching of recorder polarity. Unlike thermal conductivity and helium ionization detectors previously used for gas chromatographic analysis of soil atmospheres, the ultrasonic detector is not adversely affected by gases found in soil atmospheres and permits determination of these gases at concentrations ranging from less than 10 ng/ml to 100 percent.

33736 Lead adsorption by montmorillonite using a competitive Langmuir equation. Griffin, R.A.; Au, A.K. *Soil Sci. Soc. Am. J.;* **41**: No. 5, 880-882(1977).

The adsorption of Pb from pure $Pb(NO_3)_2$ solutions by Ca-montmorillonite at pH 5.00 and 25°C was found to be sensitive to the weight of the clay sample. This apparent sensitivity of the adsorption of Pb to the weight of the sample was attributed to Ca competition for exchange sites as determined from Pb/Ca ratios found in the solutions. Adsorption of Pb from 0.1M $Ca(ClO_4)_2$ solutions was substantially lower and was insensitive to the weight of the clay sample. This further supported our conclusion that adsorption of Pb was dependent on the Pb/Ca ratio. Application of the "simple" Langmuir equation to Pb adsorption by 0.05 and 0.10 g of clay resulted in a linear relation over the entire concentration range (0 to 1,200 ppM Pb). However, increasing nonlinearity was observed at the lower Pb concentrations when 0.50 and 1.00 g of clay were used, respectively. These Langmuir plots yielded lower adsorption maxima than maxima obtained from the two lower weights of clay and the shapes of the isotherms indicated two distinct regions of adsorption. The data were then plotted according to a "competitive" Langmuir equation, which successfully resolved the data for all four weights of clay into a single linear adsorption plot.

33737 Influence of exchangeable cation on the sorption of trace amounts of cadmium by montmorillonite. Garcia-Miragaya, J.; Page, A.L. (Univ. of California, Riverside). *Soil Sci. Soc. Am. J.;* **41**: No. 4, 718-721(1977).

The effect of different exchangeable cations on the sorption of trace amounts of Cd by montmorillonite (clay fraction, Upton, Wyoming) was studied by equilibrating samples of homoionic clay suspensions with $CdCl_2$ solutions ranging from 15 to 120 μg Cd/liter. These Cd concentrations are similar to those found in natural and contaminated soil-water systems. The amount of Cd sorbed on the montmorillonite surfaces depended on the kind of exchangeable cation, decreasing in the order Na-montmorillonite greater than K-montmorillonite greater than Ca-montmorillonite greater than Al-montmorillonite, Exchangeable Al was found to be particularly effective in reducing Cd sorption by high energy sites on montmorillonite.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33722, 33758

SOIL

33738 Effect of inorganic and organic compounds on the extractability of ^{239}Pu from an artificially contaminated soil. Nishita, H.; Haug, R.M.; Rutherford, T. *J. Environ. Qual.;* **6**: No. 4, 451-455(1977).

The effect of a number of inorganic and organic compounds on the extractability of ^{239}Pu from a contaminated soil has been examined. This has been done on an artificially contaminated kaolinitic soil by using the equilibrium batch method of extraction. Among the 21 inorganic compounds examined, $NaHPO_4$ showed the least ^{239}Pu extractability (0.07 percent of dose) and $Na_4P_2O_7$ showed the greatest extractability (28.59 percent of dose). The compounds that showed relatively high ^{239}Pu extractability included NaF, $Na_2B_4O_7$, $Na_4P_2O_7$, Na_2CO_3, Na_2O_2, NaOH, and NH_4OH. Among the organic compounds, the order of ^{239}Pu extractability was Na acetate less than Na formate less than Na oxalate less than Na tartrate less than Na citrate. A 0.004M DTPA solution was a more effective extractant than a 0.08M citric acid solution. Aside from the chemical nature of these compounds, the ^{239}Pu extractability was influenced by soil and extractant pH, soil organic matter, equilibrium time, soil weight/extractant volume ratio, and wet-dry pretreatment of the soil.

TERRESTRIAL ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 33738

SITE RESOURCE AND USE STUDIES

REFER ALSO TO CITATION(S) 32605, 32614, 32615, 32624, 32691, 32934, 33253, 33254, 33260

33739 (CONF-7705111—, pp 11p, Paper 14, Set No. 3) **Crops on reclaimed land.** Reiss, I.H. (AMAX Coal Co., Sullivan, IN). 1977.

From Coal convention of the American Mining Congress; Pittsburgh, PA, USA (1 May 1977).

In American Mining Congress 1977 coal convention.

33740 (UCRL—13817) **Triaxial tests of alluvium. Final report.** Brandt, H. (California Univ., Davis (USA). Dept. of Mechanical Engineering). 1977. Contract W-7405-ENG-48. 88p. Dep. NTIS, PC A05/MF A01.

This report presents the results of triaxial tests of alluvium samples obtained from the Nevada Test Site, holes UE2DJ and UE2AW, at a depth ranging from 1,600 to 2,000 feet. The tests were performed at ambient temperature. The interstitial pressures were kept at 0 and 250 psi while the overburden pressures were varied from 0 to 5,000 psi. The failure envelope of the soil cap model originally proposed by the Paul Weidlinger group contains three constants. These three constants were determined for alluvium. Because the alluvium varies from sample to sample, a range of failure points are observed for identical test conditions. Consequently, an equation for the average envelope is presented along with equations for the observed upper and lower limits. The position of the elliptical cap depends on the amount of strain hardening the alluvium receives in the triaxial tests. The report explains how a typical cap is determined.

33741 Nitrogen mineralization and nitrification in a cretaceous shale and coal mine spoils. Reeder, J.D.; Berg, W.A. (Colorado State Univ., Fort Collins). *Soil Sci. Soc. Am. J.;* **41**: No. 5, 922-926(1977).

Knowledge of rates and amounts of N mineralization in geologic strata is needed to predict N availability to plants when these materials are disturbed by mining or construction and left as surface or subsurface plant-growth media. Laboratory incubations were conducted to determine ammonification and nitrification rates in a Cretaceous shale, two strip-mine coal spoils, and a soil from a strip mine in northwestern Colorado. The total N concentration in the soil (1193 ppM), a vegetated spoil (1,083 ppM), and the shale (1112 ppM) were similar, while that of the fresh spoil was lower (730 ppM). No net N mineralization was measured in the shale, and less than 6 ppM NO_3^-—N accumulated in the fresh spoil during a 168-day incubation. However, net mineralization of 49-ppM NO_3^-—N was found in the vegetated spoil and 75-ppM NO_3^-—N in the soil during the same incubation period. Nitrification of added NH_4^+ (60 ppM NH_4^+—N) was measured in the shale, spoils, and soil. Accumulated levels of NO_3^-—N were 100 ppM in the vegetated spoil and 117 ppM in the soil after a 168-day incubation. However, only

36-ppM NO_3^-—N accumulated in the fresh spoil and no NO_3^-—N accumulated in the shale during the same incubation period. Rates and total amounts of CO_2 evolution from the geologic materials resembled that from the soil, indicating considerable heterotropic microbial activity in these geologic materials. The addition of NH_4^+ did not significantly affect the rate or amount of CO_2 evolution from the geologic or soil materials, indicating that heterotropic microorganisms were capable of using the forms of N present in the geologic materials.

REGULATIONS

REFER ALSO TO CITATION(S) 33729

ENVIRONMENTAL SCIENCES, AQUATIC

BASIC STUDIES

REFER ALSO TO CITATION(S) 33675

33742 (DP-MS—77-121) **Larvae and juveniles of the brook silverside, Labidesthes sicculus.** Freitsche, R.A.; Miracle, R.D.; McFarlane, R.W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1978. Contract EY-76-C-09-0001. 10p. (CONF-780211—1). Dep. NTIS, PC A02/MF A01.

From Tennessee Valley Authority freshwater larval fish workshop; Knoxville, TN, USA (21 Feb 1978).

Protolarvae have 6 to 7 preanal and 29 to 31 postanal myomeres. Migration of the anus and pelvic buds during the metalarval phase results in 14 to 15 preanal and 24 to 25 postanal myomeres and causes a relative increase in prepelvic body length. Pectoral fins in protolarvae appear before finfold differentiation. Median fin ray development in mesolarvae appears sequentially in the caudal, anal, and soft dorsal fins, respectively. The spinous dorsal and pelvic fins differentiate in metalarvae. Protolarval pigmentation consists of numerous large melanophores on the dorsal surface of the head and on the ventral surface of the breast, and a single row of melanophores on the midventral and midlateral lines. Juvenile fish lack the full formed beak-like snout of adults.

33743 (ORNL/TM—6125) **Generalized fish life-cycle population model and computer program.** DeAngelis, D.L.; Van Winkle, W.; Christensen, S.W.; Blum, S.R.; Kirk, B.L.; Rust, B.W.; Ross, C. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 177p. Dep. NTIS, PC A09/MF A01.

A generalized fish life-cycle population model and computer program have been prepared to evaluate the long-term effect of changes in mortality in age class 0. The general question concerns what happens to a fishery when density-independent sources of mortality are introduced that act on age class 0, particularly entrainment and impingement at power plants. This paper discusses the model formulation and computer program, including sample results. The population model consists of a system of difference equations involving age-dependent fecundity and survival. The fecundity for each age class is assumed to be a function of both the fraction of females sexually mature and the weight of females as they enter each age class. Natural mortality for age classes 1 and older is assumed to be independent of population size. Fishing mortality is assumed to vary with the number and weight of fish available to the fishery. Age class 0 is divided into six life stages. The probability of survival for age class 0 is estimated considering both density-independent mortality (natural and power plant) and density-dependent mortality for each life stage. Two types of density-dependent mortality are included. These are cannibalism of each life stage by older age classes and intra-life-stage competition.

33744 Improved bypass and collection system for protection of juvenile salmon and steelhead trout at lower granite dam. Matthews, G.M.; Swan, G.A.; Smith, J.R. (National Marine Fisheries Service, Seattle). *Mar. Fish. Rev.;* **39**: No. 7, 10-14(Jul 1977).

A new and improved system for diverting, bypassing, and collecting juvenile salmon, Oncorhynchus sp., and steelhead trout, Salmo gairdneri, at Lower Granite Dam on the lower Snake River is described. Major changes from previous systems of this type include a special fish screen slot for placement of the improved traveling screen, an open gallery bypass system for routing fish around the turbines, and a collection and holding area totally supplied by gravity-flow. The system is currently being evaluated by the National Marine Fisheries Service under contract to the U.S. Army Corps of Engineers.

33745 Statistical comparison of the results from six analytical chemistry laboratories of the mercury content of muscle tissue of two species of sharks. Walker, T.I. (Arthur Rylah Inst. for Environmental Research, Victoria, Australia). *Int. J. Environ. Anal. Chem.;* **5**: No. 1, 25-33(1977).

Statistical tests were carried out on the results of chemical analysis for total mercury concentrations of replicate samples of muscle tissue of school shark Galeorhinus australis (Macleay) and gummy shark Mustelus antarcticus Guenther from six independent analytical laboratories. These tests showed that one laboratory produced results 9% below the overall average of all results, another 1% below average while the other four were all 5% above average. Moreover, one laboratory had significantly lower scatter of results than the others, and the percentage scatter (standard error expressed as a percentage of the mean) in two of the laboratories tended to diminish as the magnitude of the results increased. Correction for what were concluded to be wild points indicated that the scatter for all laboratories was below 14%.

CHEMICALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33686, 33995

33746 (CONF-780111—1) **Methodology for determination of rates of microbial transformation of polycyclic aromatic hydrocarbons in sediments.** Schwall, L.R.; Herbes, S.E. (Oak Ridge National Lab., Tenn. (USA)). 1978. Contract W-7405-ENG-26. 1p. Dep. NTIS, PC A02/MF A01.

From Symposium on methodology for biomass determinations and microbial activities in sediments; Ft. Lauderdale, FL, USA (30 Jan 1978).

33747 Toxic metals in surface waters from coal ash. Cherry, D.S. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Guthrie, R.K. *Water Resour. Bull.;* **13**: No. 6, 1227-1236(Dec 1977).

The concentrations of 10 [titanium (Ti), manganese (Mn), copper (Cu), chromium (CR), zinc (Zn), arsenic (As), selenium (Se), cobalt (Co), cadmium (Cd), and mercury (Hg)] toxic elements were measured in the water, benthic sediment, plants, invertebrates, and vertebrates of an ash basin and its drainage system at a coal-fired power plant of the Savannah River Project, Aiken, S.C., over a period of two years. During 12 months of this period the basin was essentially filled and little settling of ash occurred. In the remaining 12 months, dredging had been completed, adequate settling occurred and most of the effluent turbidity was removed. All elements were more concentrated in sediment and biota than in water, and five (Mn, Cu, As, Zn, and Se) were biomagnified by at least one biotic component as compared to concentration in benthic sediment. Plants had high accumulations of Ti, Mn, As, and Hg: invertebrates had high accumulations of Co, Hg, Cu, Cr, Cd, and As; and vertebrates greatly biomagnified Se and Zn. The streamlined biotic community of the system accomplished major removal of Mn, Zn, As, Se, and Cd from the effluent. The magnitude of bioaccumulation of Ti, Mn, Zn, As, Se, Cd, and Hg was increased during the period of adequate settling in the basin.

33748 Keeping oil out of the marine environment. *Environ. Sci. Technol.;* **11**: No. 12, 1046-1047(Nov 1977).

The bulk of tanker-generated oil in the oceans is produced by operational procedures. Exxon found that washing tanks with crude oil in part significantly reduced solution on tankers. Heavy crude oils can remove heavy oil residues. Thick layers of oil residues form as a result of the presence of water in crude oil cargo, and these layers are left on the surfaces of the holding tanks. Both sludge and clingage will resist water, but a strong jet of crude oil is able to separate oil-water emulsions, dissolving the oil portion of the residues so that it is incorporated into the rest of the cargo. (JSE)

33749 Kinetics of oxygenation of reduced sulfur species in aqueous solution. O'Brien, D.J.; Birkner, F.B. (Univ. of Maryland, College Park). *Environ. Sci. Technol.;* **11**: No. 12, 1114-1120(Nov 1977).

Kinetic studies of the oxygenation of the reduced sulfur species at pH values of 4, 7.55, and 10 were made. The reaction was determined to be first order with respect to reduced sulfur at all pH values and nearly first order with respect to oxygen at pH 7.55. Reaction products were determined, and an overall kinetic model was developed to more fully understand the complex reaction mechanism involved. The model suggested parallel reactions between reduced sulfur species and oxygen to form sulfite, thiosulfate, and sulfate. Reasonable predictions of reactant and product concentrations were obtained.

33750 Input and fate of petroleum hydrocarbons entering the Providence River and upper Narragansett Bay from wastewater effluents. Vleet, E.S.V.; Quinn, J.G. (Univ. of Rhode Island, Kingston). *Environ. Sci. Technol.;* **11**: No. 12, 1086-1092(Nov 1977).

A one-year background survey of the petroleum hydrocarbons discharged to the Providence River by a municipal wastewater secondary treatment plant indicated that these plants may be significant contributors to oil pollution in estuarine and coastal waters. The hydrocarbons were discharged primarily in association with the suspended solids. Analysis of suspended material and sediments in the river and upper Narragansett Bay indicated that approximately half of the suspended hydrocarbons were rapidly sedimented out in the river, and the remainder were transported out of the river and throughout the bay. The petroleum products were persistent to 40 cm in some sedimentary cores with the subsequent emergence of biologically produced hydrocarbons indicating the extent to which oil pollution was present in these sediments.

33751 Cryogenic sediment sampler. Walkotten, W.J. US Patent 4,038,875. 2 Aug 1977. Filed date 18 May 1976. 4p.

A stream bed sediment sampler easily obtains a nearly undisturbed, stratified sample containing stream gravel, intergravel water, and organic material. The temperature of a probe inserted into the sediment is quickly reduced to a point where the material immediately surrounding the probe freezes and clings to the probe upon its removal from the stream bed. The equipment is inexpensive, easy to assemble, and portable. Determining the effects of industrialization, mining, farming, road building, logging, etc., on the surrounding environment is important. Of particular importance to the fishing industry are programs designed to detect environmental changes in streams, rivers, lakes, bays, etc., used by spawning salmon and the like. Many of these changes are small, and sensitive techniques are needed to detect them. This sampler is suited for such a purpose.

33752 Stability considerations in a class of hierarchical dynamic environmental control systems. Perlis, H.J. (New Jersey Inst. of Tech., Newark); Chichester, F.D. pp 45-49 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

Techniques for determining stability for a class of dynamic water quality control systems with a distributed hierarchical structure are discussed. An adaptive control approach using the performance index as a Liapunov function is presented. The effect of lags caused by decomposition is handled for the discrete system by employing z-transform methods.

33753 Finite-difference modeling of dynamic concentrations balances distributed along two spatial axes in a polluted waterway. Chichester, F.D. (Austin Co., Roselle, NJ). pp 387-391 of Modeling and simulation. Volume 8, Part 1. Vogt, W.G.; Mickle, M.H. (eds.). Pittsburgh; Instrument Society of America (1977).

From 8. annual conference on modeling and simulation; Pittsburgh, PA, USA (21 Apr 1977).

See CONF-770438—P1.

The mass conservation principle is applied to a typical volume element of a tapered waterway for dynamic convection, dispersion and first order decay reaction balances. The resulting finite difference equations, representing dynamic balances distributed along two spatial axes, are assembled into a two-step model in which the convection balances are modeled separately from the remaining balances. This two-step discrete model of the dynamic concentrations balances in a stratified estuary defines a fairly broad class of waterway models. A discrete volume flow rate distribution, including tidal and salinity effects, is developed for use with this class of models.

33754 Sampling and storage of natural waters for trace metal analysis. Batley, G.E.; Gardner, D. (n Atomic Energy Commission, Lucas Heights, Australia). *Water Res.;* **11**: No. 9, 745-756(1977).

Methods for the collection, preservation and storage of natural water samples for the analysis of trace levels of heavy metals have been critically reviewed, with particular reference to the analysis of zinc, copper, lead, cadmium and mercury. Recommended procedures are given which minimize the problems of sample contamination and adsorption losses. Carefully cleaned high-density polythene or Teflon containers are recommended for both sampling and storage, with a storage temperature of 4°C. Acidification to 0.05 M H^+ with nitric acid is desirable, except in speciation studies. For mercury analysis the addition of an oxidant or complexing agent is also necessary.

33755 Fate of chlorine in seawater. Wong, G.T.F.; Davidson, J.A. (Woods Hole Oceanographic Inst., MA). *Water Res.;* **11**: No. 11, 971-978(1977).

The consumption of hypohalite (or chlorine demand) in seawater seems to occur in two phases. Residual chlorine concentration decreased rapidly within the first hour and noticeably slower afterwards. Total consumption of up to 3.3 ppM chlorine was observed within 30 h. The chlorine demand increased with increasing initial hypohalite concentrations and increasing time of contact. No limit of chlorine demand was observed. Data from ultraviolet spectroscopy suggest that the hypochlorite reacts with bromide ion to form hypobromite. The reaction is fast and seems to reach completion within 2.5 min. Hypobromite is thus the major species measured as residual chlorine which is consumed in sea-water. One of the products can liberate iodine from iodide at low pH (pH 1.4). This species, however, is not bromate and it decomposes with time. Further studies on the chemistry and toxicity of bromine containing species in chlorinated sea-water will be necessary in order to realize fully the environmental impact of the chlorination of sea-water.

33756 Trace metal enrichment on chemically modified filter papers. Gendre, G. (Univ. of Geneva, Switzerland); Haerdi, W.; Linder, H.R.; Schreiber, B.; Frei, R.W. *Int. J. Environ. Anal. Chem.;* **5**: No. 1, 63-75(1977).

A trace enrichment technique for preconcentration of heavy metals on thiocarbaminate modified filter papers is described. The technique has been studied for Cu^{2+}, Fe/sup 2+ and 3+/, Zn^2Pb^{2+}, Ni^{2+}, As^{3+}, Sb^{3+}, Cd^{2+}, Hg^{2+}, VO^{2+} and UO_2^{2+}. Up to 100 μg of metal can be retained within one to two hours on the filter. Effects of filter treatment of flow conditions and pH on filter capacity, filter permeability and recovery have been studied. Best recoveries were obtained in the pH range of 5-6. Considerable improvement on stability of the samples and reproducibility was achieved by subjecting the filters to high prssures prior to measurement. The technique was applied to the analysis of metal traces in ultra pure water samples (lower PPB range) and in organic samples by x-ray fluorescence.

33757 Biodegradation of some cationic surfactants media. Balleux, B.; Caumette, P. (Univ. des Sciences et Techniques du Languedoc, Montpellier, France). *Water Res.;* **11**: 833-841(1977). (In French).

Cationic surfactants were shown to have no bacteriostatic or bacteriolytic action on the heterotrophic bacterial populations isolated from sewage and river waters, contrary to what happens with pathogenic bacteria such as Staphylococcus. The cationic surfactant biodegradation in sewage and river water was studied, measuring the reduction of the active substance by a colorimetric method using sodium alizarine sulfonate. Among the ten products tested (15 ethoxymethyl distearyl ammonium chloride—hexadecyltrimethylammonium chloride and bromide—dodecylpyridinium iodide—hexadecylpyridinium bromide—laurylpyridinium chloride—diisobutylphenoxyethoxyethyl benzyl dimethylammonium chloride—quaternary alkylimidazolium compound—ethoxylated tertiary alkyl primary amines—dimethyldistearylammonium chloride) and in experimental conditions clearly specified, half of them, including straight-chain alkylammonium compounds, are degraded, the other half are not. These are cyclical alkylammonium compounds and petroleum derived cationics. Extent of biodegradation is then assessed by infrared spectroscopy.

RADIOACTIVE MATERIALS MONITORING AND TRANSPORT

REFER ALSO TO CITATION(S) 33722

33758 (ORO—3852-26) **Plutonium flux into the Gulf of Mexico. Progress report.** Scott, M.R. (Texas A and M Univ., College Station (USA)). 1978. Contract EY-76-S-05-3852. 27p. Dep. NTIS, PC A03/MF A01.

Progress is reported on the following projects: expansion of equipment and facilities; sampling procedures; analysis of river samples for ^{238}Pu, ^{239}Pu, and ^{240}Pu; analyses of river bottom sediments; factors determining the concentration of fallout nuclides in soil and sediment samples; analyses of river sediments for ^{234}U, ^{238}U, and ^{230}Th; and geographic variation in sediments. (HLW)

WATER

33759 (PNCT—831-75-02, pp 195-199) **Plutonium contents in marine environmental samples.** Imakuma, Y.; Nomura, T.; Yamato, A.; Kurabayashi, M.; Kinoshita, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Dec 1975.

In Semi-annual progress report of Power Reactor and Nuclear Fuel Development Corporation, Tokai Works. Jan—Jun 1975.

This paper contains the results of the analysis of plutonium contents in the sea water near the nuclear facilities and the sediment of offshore Tokai. The results are compared with the concentration of plutonium in the sediments of other regions in Japan. The procedure for the analysis of plutonium in sediment and sea water is explained schematically. The sampling was made at 18 stations of offshore Tokai. The plutonium content in the sediment of offshore Tokai ranged from 4 to 41 pCi/kg-dry, and that in other regions from 5.1 to 130 pCi/kg-dry. The concentration of plutonium in coastal water of Tokai-mura and its vicinity is shown in a table, and

it ranged from 0.5 to 1.2 pCi/1000l. The vertical distribution of plutonium in sediment was also studied. As a result of a series of the monitoring, the fallout plutonium in marine samples is maldistributed locally, even in the restricted area such as the shore Tokai. The concentration of plutonium in the sediment of offshore Tokai was in the range of the local variation among those in other regions in Japan.

AQUATIC ECOSYSTEMS AND FOOD CHAINS

REFER ALSO TO CITATION(S) 33759

THERMAL EFFLUENTS MONITORING AND TRANSPORT

33760 (PB—272633) **Mixing of power-plant heated effluents with the missouri river.** Caro-Cordero, R.; Sayre, W.W. (Iowa Inst. of Hydraulic Research, Iowa City (USA)). Jun 1977. 144p. (IIHR—203). NTIS PC A07/MF A01.

Thermal plume data obtained in the Missouri River downstream from the Fort Calhoun and Cooper Nuclear Stations, together with detailed information about the channel geometry needed to synthesize the transverse flow distribution are used to adapt and refine a mathematical model for steady-state transverse mixing in natural streams for the purpose of predicting thermal plumes in fast-flowing turbulent rivers such as the Missouri River. In addition to the transverse distribution of flow, the model requires two parameters, one relating to the initial near-field dilution resulting from the interaction of the thermal discharge with the ambient flow, and the other governing the far-field transverse mixing due to mechanisms associated with the ambient flow. Twelve sets of plume data are analyzed to determine the values of the parameters which provided the best agreement between observed and computed distributions of temperature rise with respect to cumulative discharge across the channel. The model is found to provide a good basis for predicting thermal plumes in the Missouri River and similar streams.

REGULATIONS

REFER ALSO TO CITATION(S) 33252, 33729

ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

SOCIAL AND ECONOMIC STUDIES

REFER ALSO TO CITATION(S) 33198, 33203, 33204, 33207, 33731

ASSESSMENT OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 32934, 32975, 33198, 33204, 33211, 34020

33761 (PB—272759) **Development status and environmental hazards of several candidate advanced energy systems. Final report Dec 75—Feb 76.** Penny, M.; Bourgeois, S. (Lockheed Missiles and Space Co., Huntsville, Ala. (USA)). Jun 1977. Contract EPA-02-1331. 111p. NTIS PC A06/MF A01.

The report gives a review of the development status of several advanced energy concepts and discusses the primary environmental hazards of each system. Systems reviewed include potential new sources of energy and improved energy conversion. Each system is evaluated with respect to its development status, and estimates made as to when each will begin to contribute significantly to U.S. energy needs. Appraisals were made of the environmental impact of each system including assessment of the adequacy of pollution control technology and potential gross ecological impact. Considering both the expected environmental impact and period of technology break through/commercialization, the following order of RandD priorities on the candidate energy systems has been developed: high temperature turbines, ocean thermal gradients, windmills, magnetohydrodynamics, metal vapor (potassium) Rankine topping cycles, hydrogen fuel cells, thermionics, electrogasdynamics, and thermoelectric conversion.

33762 **Environmental protection sets new research targets.** Behrens, D. (DECHEMA Deutsche Gesellschaft fuer Chemisches Apparatewesen e.V., Frankfurt am Main (Germany, F.R.)). pp 5 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection. International congress on energy and environment; Duesseldorf, Germany, F.R. (8 Feb 1977).

After a listing in tabular form of the R + D subjects named by the project group 'Techniques with a concern for the environment', i.e. waste management on the energy sector, transport techniques with a concern for the environment, waste management in the coal and steel industry, and waste management in the chemical industry, subjects with prime importance for future research are presented. The planning method and the evaluation of the future research tasks are explained and illustrated by the example of cellulose production. The contribution concludes by considering the influence of specific quality criteria and by pointing out hindrances in transforming industrial environmental protection problems into R + D projects.

ENVIRONMENTAL IMPACT STATEMENTS

REFER ALSO TO CITATION(S) 32864

BIOMEDICAL SCIENCES, BASIC STUDIES

BEHAVIORAL BIOLOGY

REFER ALSO TO CITATION(S) 33743

33763 **Post-breeding activities of mallards and wood ducks in north-central Minnesota.** Gilmer, D.S.; Kirby, R.E.; Ball, I.J.; Riechmann, J.H. (Univ. of Minnesota, St. Paul). *J. Wildl. Manage.;* **41**: No. 2, 345-359(Jul 1977).

We used radio telemetry to monitor the post-breeding activities of 129 mallards (Anas platyrhynchos) and 118 wood ducks (Aix sponsa) on a 932-km² area in north-central Minnesota from 1968 to 1974. Upon completion of breeding activities and before the flightless period, all mallard drakes departed the area; this exodus peaked during early June. Of the non-brood hens 8 of 23 remained on the area, whereas 26 of 51 of the hens raising broods spent the flightless period on their breeding areas. Thirty-nine percent of the mallard hens on the area in the spring were present at the beginning of their flightless period. Fifty percent of the drake wood ducks and 41 percent of the hens left the breeding area before flightlessness. Their timing was similar to that of mallards. The flightless period began in mid-June for wood duck drakes and lasted into early October for some mallard hens. All late molting mallard and wood duck hens reared broods that same year. A minimum of 35 percent of the spring mallard hens remained on the area at the beginning of hunting season (early October). About 17 percent of the wood duck males and 42 percent of the females breeding locally remained on the area until hunting began. Eleven of 51 mallards and 4 of 25 wood ducks that reared broods were killed on the study area compared with 2 of 23 for non-brood mallards and 1 of 20 for non-brood wood duck hens. Principal habitats used by post-breeding mallards were bays of large lakes and river marshes. Wood ducks tended to use similar habitat but also frequented small woodland ponds. During the flightless period both species remained mostly in areas with abundant emergent cover.

33764 **Feeding ecology of wood ducks in South Carolina.** Landers, J.L. (Univ. of Georgia, Athens); Fendley, T.T.; Johnson, A.S. *J. Wildl. Manage.;* **41**: No. 1, 118-127(Jan 1977).

Wood ducks (Aix sponsa) were studied from August 1973 to August 1975 at the Savannah River Plant of the U.S. Energy Research and Development Administration in South Carolina. Two hundred feeding wood ducks were collected for study of food habits and nutrition in relation to foraging habitat use. Animal matter in the diet of females increased markedly during the breeding season and was greater ($P < 0.05$) than for males. Dietary protein and ash peaked during egg-laying but decreased sharply in May when nitrogen-free extract was lowest of any month and crude fiber was highest; low weights of ducks also indicated a lean period. Percent dietary protein and fat, and weights of ducks were higher during fall of 1973 when there was a good mast crop than during 1974 when a mast failure occurred. Females fed on invertebrates in shallow, open water in spring. Both sexes used deeper water areas for feeding on succulent vegetation during early summer and concentrated in Carolina bays to feed on seeds of pad plants in late summer and early fall. As fall progressed, foraging shifted to seasonally flooded stream swamps.

BIOCHEMISTRY

REFER ALSO TO CITATION(S) 33506, 33507, 33508, 33509, 33789, 33801, 33822, 33843, 33872, 33874, 34004

33765 (CONF-760927—, pp 162-180) **Biochemical studies on normal and hormone-accelerated development of pulmonary surfactant.** Rooney, S.A.; Motoyama, E.K. (Yale Univ., New Haven, CT). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

To elucidate the biochemical events relating to surfactant during fetal and early postnatal development, we examined the phospholipid content and composition of rabbit lung lavage and tissue during the period 27 days' gestation (full-term, 31 days) to 2 days after birth. We also examined the activities of enzymes involved in the synthesis of pulmonary phosphatidylcholine and phosphatidylglycerol--the major surface-active components of surfactant--from 19 days' gestation. In addition, since corticosteroids and thyroxine are known to accelerate fetal lung maturation, we examined the effect of cortisol and thyroxine administration to the fetuses at 24 to 25 days on pulmonary phospholipid content, composition, and biosynthesis at 27 days. There was a four-fold increase in the amount of total phospholipid in lung lavage during the period 27 to 31 days. There was a further 10-fold increase to adult levels 1 day after birth. During the same period phosphatidylcholine increased from 29% of the total phospholipid at 27 days to 68% at 31 days and 80% after birth, whereas sphingomyelin decreased from 38% of the total at 27 days to 7% at 31 days and 2 to 3% after birth. During fetal development the activity of pulmonary choline kinase changed little, that of cholinephosphate cytidylyltransferase, cholinephosphotransferase, and glycerophosphate phosphatidyltransferase decreased, whereas that of 1-acylglycerophosphate and lysolecithin acyltransferases increased. There was a postnatal increase in the activities of cholinephosphate cytidylyltransferase, cholinephosphotransferase, and both acyltransferases.

33766 (CONF-760927—, pp 223-235) **Cytochemical study of glucose-6-phosphate dehydrogenase in prenatal and postnatal rat lungs.** Negi, D.S.; Lunan, K.D.; Stephens, R.J. (Stanford Research Inst., Menlo Park, CA). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Glucose-6-phosphate dehydrogenase (G6PDH) was localized in rat lungs at different stages of gestation, on the day of birth, and in the adult animal. The first indication of the enzyme activity was observed in the epithelial cells of the elongating lung buds at about 14 days of gestation. This activity was restricted to the apical portion of the cells lining the developing airways. Between 16 and 18 days of gestation, the intensity of the reaction gradually increased in the epithelial cells of the bronchioles, and enzyme activity also appeared in alveolar type II cells. By the day of birth, the G6PDH activity had intensified considerably, but its distribution pattern remained unchanged. Adult lungs had achieved maximum intensity prior to 40 days of age.

33767 **Specialized DNA polymerases in lymphoid cells.** Baltimore, D.; Silverstone, A.E.; Kung, P.C.; Harrison, T.A.; McCaffrey, R.P. (Massachusetts Inst. of Tech., Cambridge). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 63-72(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Terminal transferase remains the only good candidate for a somatic-mutation-producing DNA polymerase. It is clearly found that in immature, but not in mature, T cells. It is also found in a population of bone marrow cells that lack an inducible T-cell marker and that could be B-cell precursors (but might well be unrelated to B cells). The most suggestive observation that could be interpreted as evidence for terminal transferase in pre-B cells is the occurrence of activity in Abelson virus-induced tumor cells. The status of Abelson tumor cells is, however, uncertain.

33768 **Comparative chemical analyses and partial amino acid sequences of the heavy chains of HL-A antigens.** Appella, E. (National Cancer Inst., Bethesda, MD); Tanigaki, N.; Henriksen, O.; Pressman, D.; Smith, D.F.; Fairwell, T. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 341-342(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

We have compared several structural parameters of two papain-solubilized HL-A antigen preparations, both isolated from the human lymphoid cell line RPMI 1788. The heavy chains obtained from the two preparations carried the allospecificities A2 and B7,14, respectively, and were thus partially different from the antigens studied by other investigators. The total carbohydrate content of the heavy chain was 12.9%; the individual carbohydrates are listed. Amino acid analyses were carried out in duplicates of approximately 1.3 nmole of each of the isolated large components, and the number of residues was calculated based on a molecular weight of 30,000. It can be seen that although the amino acid compositions of the two proteins were extremely similar, they nevertheless differed by 15 residues (sum of differences irrespective of sign) involving 13 amino acid. Tryptic peptide maps of the two antigen preparations were also very similar but they also showed significant differences.

33769 **Structural differences between parent and variant H-2K glycoproteins from mouse strains carrying H-2 gene mutations.** Nathenson, S.G. (Albert Einstein Coll., Bronx, NY); Brown, J.L.; Ewenstein, B.M.; Nisiszawa, T.; Sears, D.W.; Freed, J.H. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 243-249(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

We have shown that there is a structural difference in the H-2K products of the mutants B6.M505 (H-2/sup bd/), B6.C-H-2/sup ba/ (Hzl) and the parent B6 (H-2/sup b/). This finding suggests that this difference is related to the biological reactivity between cells carrying these respective products. The mutation in the case of M505 appears to be discrete and localized to one fragment. That fragment carries the carbohydrate and is still relatively large (approximately 8000 daltons, not including the carbohydrate) and is internally located in the K molecule. The biological and serological relationships of the H-2/sup ba/ and H-2/sup bd/ mutants and parent also fit with the suggestion that there are separate sites for biological cell-to-cell interaction distinct from the sites for humoral antibody interaction.

33770 **Structure of murine histocompatibility antigens.** Cunningham, B.A.; Henning, R.; Milner, R.J.; Reske, K.; Ziffer, J.A.; Edelman, G.M. (Rockefeller Univ., New York). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 351-362(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

H-2 antigens were characterized by physicochemical methods, by peptide mapping techniques, and by radiochemical amino acid sequence analysis. The combined data provide a working model of these molecules in solution and on the cell surface that includes the organization of the heavy (m.w. 46,000) and light (m.w. 12,000, β_2-microglobulin) chains and the orientation of the heavy chains with respect to the cell surface. H-2K and H-2D heavy chains from all haplotypes have many features in common, but there are distinct differences in molecular weight, peptide maps, and amino acid sequence that appear to reflect the genetic polymorphism of the H-2 system. The amino acid sequences of the H-2 heavy chains are homologous to those reported for the HL-A antigens. The sequences of the mouse and human proteins are much more divergent than those of the β_2-microglobulins associated with them. Similar approaches also analyze the structure of the heavy chain of the TL antigen from ASL-1 cells.

33771 **Chemical characterization of products of the H-2 complex.** Silver, J.; Cecka, J.M.; McMillan, M.; Hood, L. (California Inst. of Tech., Pasadena). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 369-377(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: general features of the H-2 complex; isolation and preliminary chemical characterization of transplantation molecules; amino acid sequence analysis of the K and D molecules; genetic and evolutionary implications of N-terminal amino acid sequences of transplantation antigens; general properties of the I-region-associated (IA) alloantigens; and chemical characterization of Ia molecules. (HLW)

33772 **Human Ia antigens: purification and molecular structure.** Snary, D. (National Inst. for Medical Research, Mill Hill, London); Barnstable, C.; Bodmer, W.F.; Goodfellow, P.; Crumpton, M.J. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 379-386(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

A model summarizing our current knowledge of the molecular nature of the human Ia antigens is depicted. The antigens comprise two glycosylated polypeptides of molecular weight 33,000 and 28,000 that are noncovalently linked. The 33,000-m.w. polypeptide is coded by a gene within the major histocompatibility complex that is presumably closely linked to the D locus, whereas the 28,000-m.w. polypeptide is probably coded by a gene on a different chromosome. In this case, the 33,000-m.w. chain carries the polymorphic serological specificities detected by allogenic antisera. At least a portion of one of the polypeptides is hydrophobic and is inserted into the lipid bilayer of the membrane. Alternative arrangements are that one chain only is inserted into the lipid, that it fails to span the membrane, or that it loops through the lipid so that its terminus is exposed on the outer surface of the membrane.

33773 Three-dimensional structure and diversity of immunoglobulins. Poljak, R.J.; Amzel, L.M.; Chen, B.L.; Chiu, Y.Y.; Phizackerley, R.P.; Saul, F.; Ysern, X. (Johns Hopkins Univ., Baltimore). pp 639-645 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

A three-dimensional model was built based on an electron density map calculated with amplitudes measured with a four-circle single-crystal diffractometer, and phases were obtained by use of the multiple isomorphous heavy-atom-replacement technique. The electron density map was fitted using the amino acid sequence of the light chain of JgG and the amino acid sequence of the Fd fragment of the heavy chain. Results are discussed with regard to the following: the immunoglobulin fold; the combining site; immunoglobulin variants; and mutation and antigen selection. (HLW)

33774 Origins of antibody diversity: insights gained from amino acid sequence studies of elicited antibodies. Haber, E.; Margolies, M.N.; Cannon, L.E. (Massachusetts General Hospital, Boston). pp 647-659 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Rabbits are repetitively immunized with either type-III or type-VIII pneumococcal whole-cell vaccines. Antibodies produced are for the most part specific for the capsular polysaccharide of the organism. The structures of type-III (S3) and type-VIII (S8) polysaccharides are relatively simple. Both are unbranched linear polymers. S3 is comprised of a repeating disaccharide, whereas S8 is a repeating tetrasaccharide. Among outbred rabbits repetitively immunized with these antigens, restricted responses consisting of high concentrations of one or a few antibody components are quite frequent. These antibodies are easily purified to homogeneity by either affinity chromatography utilizing polysaccharide-protein conjugates linked to sepharose or by ion-exchange chromatography on DEAE-cellulose. Thus, without resorting to a breeding program, it is possible to obtain sufficient amounts of homogeneous antibody components for detailed structural analyses.

33775 Primary structural differences in myeloma proteins that bind the same haptens. Potter, M.; Rudikoff, S.; Vrana, M.; Rao, D.N.; Mushinski, E.B. (National Cancer Inst., Bethesda, MD). pp 661-666 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

In this paper, we present new and recently published amino acid sequences of antigen-binding myeloma proteins of BALB/c origin, with specificity for phosphorylcholine (PC), inulin, and β-1,6,6 D-galactan. The origin and source of these and other related myeloma proteins are tabulated. As can be seen, with the exception of CBPC-2 and CBPC-4, which were derived from plasmacytomas induced in the immunoglobulin (Ig)-congenic C.B/20 mouse (BALB/c mouse carrying I/sub g/C/sub H/-V/sub H/ loci of C57BL/ka origin), all the myeloma proteins were derived from tumors induced in BALB/c mice by mineral oils and related substances. In each group, there are eight or more proteins. X-ray crystallographic analysis of human and mouse V domains has indicated remarkable homologies in structure in the framework portions of the V/sub H/ and V/sub L/ chains. These regions govern the folding of the domains and the interdomain interactions and thus determine, to a large extent, the molecular architecture. The chief structural variations that occur in Ig V domains are located in the complementarity-determining regions (CR).

33776 Folding, association, and interactions of domains in the antibody molecule. Givol, D.; Sharon, J.; Hochman, J.; Gavish, M.; Inbar, D.; Pecht, I.; Steinberg, I.Z.; Schlessinger, J. (Weizmann Inst. of Science, Rehovot, Israel). pp 667-675 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

These studies concentrated on some aspects of folding and association of the V domains in antibodies and on interdomain interactions in the antibody molecule. V domains, which are only half of L chain or a quarter of H chain, can refold from a completely unfolded state to regain native structure and activity. This implies that the entire information for folding of Ig domain is present in its amino acid sequence and is independent of the rest of the polypeptide chain. This case is unique to immunoglobulins and is the basis for their domain structure. The association constant between V/sub L/ and V/sub H/ is greater than 10^8 M^{-1} and is strong enough to hold them as an active fragment. Fv fragment can be prepared by associating V/sub L/ with H and subsequently digesting the recombinant to yield Fv. The interaction of V domain with its neighboring C domain is stronger when associated with the other chain in the Fab than when separated from the other chain. Antigen or hapten binding causes conformational changes in the Fab and Fc portions of the antibody, and some of the changes occur only when the ligand is large enough and fills the site.

33777 Response of rabbits to streptococcal hyperimmunization. Fraser, B.A.; Johnstone, A.P.; Gordon, S.M.; Kindt, T.J. (Rockefeller Univ., New York). pp 689-698 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The serological and structural analyses of molecularly uniform rabbit antibodies to streptococcal carbohydrate have provided information relevant to questions concerning gene expression in the immune response. The presence of several copies of the V/sub H/ gene for each group-a allotype is indicated, and the existence of H-chain subgroups has been demonstrated. In contrast, only one C/sub H/ gene (with allotypic variants) for IgG is indicated by available data. The genetic basis of L-chain diversity remains obscure. Multiple copies of C/sub K/ genes may exist for each group-b allotype. Each b allotype is associated with a different and distinct pool of V genes. Genetic experiments using L-chain-specific idiotypes as V/sub L/-region markers may resolve questions concerning light-chain V genes. Final interpretation of the above data must consider the possibility that regulation of gene expression can occur at many stages in antibody synthesis. It is anticipated that further studies on the genetic markers in each region of the antibody molecule will elucidate both the number of genes involved in the immune response and the means by which their expression is regulated. In addition, examination of other products produced during the course of streptococcal hyperimmunization may further our understanding of the immune system.

33778 Structure and immunosuppression of a cross-reactive idiotype associated with anti-p-azophenylarsonate antibodies of strain-A mice. Ju, S.T.; Owen, F.L.; Nisonoff, A. (Brandeis Univ., Waltham, MA). pp 699-707 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

In this paper we summarize some of our recent studies on the anti-p-azophenylarsonate (anti-Ar) antibodies of strain-A mice. The work includes structural studies of antibodies with shared idiotype. Investigations relating to the immunosuppression of the cross-reactive idiotype and to the "private" idiotypes of anti-Ar antibodies arising in immunosuppressed immunized mice are also included. Among the new data are those based on the adoptive transfer of idiotypes, using leukocytes from ascitic fluids, rather than spleen cells; mice that are suppressed with respect to a cross-reactive idiotype, but which express a private idiotype, are the donors in these experiments. We present data on the identification and isolation, by a rosetting technique, of T cells with receptors specific for an idiotype. These T cells appear in mice that are immunologically suppressed with respect to the cross-reactive idiotype.

CYTOLOGY

REFER ALSO TO CITATION(S) 33767, 33838, 33865, 33866, 33869, 33870, 33871, 33873, 33880, 33887, 33888, 33889, 33890, 33904, 33988

33779 (CONF-760927—) **Pulmonary macrophage and epithelial cells.** Sanders, C.L.; Schneider, R.P.; Dagle, G.E.; Ragan, H.A. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1977. 628p. Dep. NTIS, PC A07/MF A01.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

Separate abstracts were prepared for the 41 papers presented at the conference. Abstracts of two papers have appeared in previous issues of Energy Research Abstracts. (HLW)

33780 (CONF-760927—, pp 22-35) **Bactericidal mechanisms in rat alveolar macrophages.** Biggar, W.D.; Sturgess, J.M. (Hospital for Sick Children, Toronto). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

The bactericidal mechanisms in rat alveolar macrophages have been examined. Cytochemical techniques were used to study peroxidase activity in alveolar macrophages and to compare the peroxidase activity to that in blood neutrophils. No significant peroxidase was detected in alveolar macrophages, whereas blood neutrophils showed abundant peroxidase activity in primary lysosomal granules and in phagosomes following particle ingestion. Because of these observations, functional studies of myeloperoxidase and hydrogen peroxide were pursued. Results suggested that peroxidase—hydrogen peroxide mediated bactericidal reactions may not be important in alveolar macrophages. Lysozyme-dependent bacterial killing appeared to be more significant. Alveolar macrophages contained 10-fold more lysozyme than blood neutrophils. The killing of Micrococcus lysodeikticus, a lysozyme-dependent event, was significantly greater by alveolar macrophages than by neutrophils. This reaction was shown to be dependent on lysozyme and to occur extracellularly. These results suggest that, in contrast to neutrophils, where oxidative-dependent bactericidal mechanisms appear to be important for microbial killing, alveolar macrophages may use, at least in part, lysozyme-dependent bactericidal mechanisms to contribute to pulmonary defenses.

33781 (CONF-760927—, pp 36-57) **Effect of cigarette smoke on macrophage phagocytosis.** Haroz, R.K.; Mattenberger-Kreber, L. (Battelle Geneva Research Center, Carouge, Switzerland). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

This paper describes a reproducible method that was developed for and permits the assessment of the effects of different smoking products on the basis of macrophage phagocytosis. The method routinely uses mouse peritoneal macrophages but yields similar findings when pulmonary macrophages from guinea pigs are used. The test uses the uptake of ^{51}Cr-labeled opsonized sheep red blood cells as a quantitative measure of macrophage phagocytosis. At low concentrations of aqueous extracts of cigarette smoke, a dose-response curve for red-cell ingestion can be obtained. The test is sensitive to different cigarettes and filter types. The testing of cigarettes equipped with different filters suggested a role for vapor-phase components in the toxic process but not exclusive of particulate matter. The depressant activity in smoke is moderated in the presence of thiols, such as glutathione or cysteine, which suggests a possible role for oxidants or free radicals in the smoke as responsible agents for the inhibitory effect on macrophage phagocytosis. The addition of a nontobacco substitute material to a tobacco cigarette decreased the depressant activity of 100% tobacco smoke. A statistically significant difference was demonstrable between a 100% tobacco cigarette and cigarettes containing either 25 or 50% substitute. A further difference of similar magnitude existed between the two sample blends and the cigarette containing 100% substitute material. On a per cigarette basis, the nontobacco material was approximately fourfold to fivefold less toxic than tobacco. The comparison of the smoke chemistry of all cigarettes examined did not implicate a single class of compounds as the responsible toxic agent.

33782 (CONF-760927—, pp 66-77) **Enhanced binding of autologous red cells to the macrophage plasma membrane as a sensitive indicator of pollutant damage.** Hadley, J.G. (Duke Univ. Medical Center, Durham, NC); Garnder, D.E.; Coffin, D.L.; Menzel, D.B. 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

The alveolar macrophage (AM) represents the primary line of defense in host protection against inhaled infectious organisms. Following exposure to oxidant gases, the ability of the host to resist airborne bacterial infection is severely impaired. Oxidant exposure could diminish the phagocytic capability of the macrophage system by either altering the phagocytic process per se, or acting on cell surface structures responsible for the recognition and binding of material to the phagocyte. So that possible damage by oxidant exposure on the AM recognition mechanisms could be investigated, macrophages were isolated from rabbits and treated with a commercial preparation of wheat germ lipase. This treatment induced the binding of both heterologous (sheep) and autologous (rabbit) red blood cells to AM. The 50% effective concentration (EC_{50}) for rosette formation with the crude commercial preparation was 30 μg/ml for heterologous cells and 300 μg/ml for autologous cells. Macrophages isolated from rabbits exposed to 0.981 mg O_3/m^3 (0.5 ppM) for 3 hr or 3.167 mg NO_2/m^3 (7.0 ppM) for 24 hr exhibited increased binding of autologous cells. In the presence of 100 μg/ml of lipase, control cells formed 7.2 +- 1.4% rosettes compared to 66.0 +- 13.7% for cells treated with ozone and 51.7 +- 21.1% for cells treated with nitrogen dioxide. So that the oxidant alteration of the macrophage membrane could be further characterized, a highly purified, radiolabeled preparation of wheat germ agglutinin (WGA) was used as a probe of membrane structure. Preliminary evidence suggests that the oxidants increase the binding of WGA to the macrophage surface. This enhanced binding could be due either to the revelation of cryptic binding sites or the rearrangement of preexisting sites. Both of these alternatives could impair the recognition capability of the AM and therefore diminish the protective activity of the AM.

33783 (CONF-760927—, pp 78-84) **Alveolar macrophages: phagocytosis-induced release of neutrophil chemotactic activity.** Roos, B.; Keller, H.U.; Hess, M.W.; Cottier, H. (Univ. of Bern). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Rabbit alveolar macrophages induced with bacillus Calmette-Guerin release little if any measurable chemotactic activity in vitro. Neutrophil cytotaxins or rapidly activatable precursors or both can be demonstrated in lysates of such cells. Neutrophil chemotactic activity is released from alveolar macrophages following the ingestion of zymosan or immune complexes.

33784 (CONF-760927—, pp 85-105) **Effect of particle size on regurgitative exocytosis by rabbit alveolar macrophages.** Sandusky, C.B.; Cowden, M.W.; Schwartz, S.L. (Georgetown Univ. Schools of Medicine and Dentistry, Washington, DC). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Current hypotheses on the etiology of environment-induced chronic obstructive pulmonary disease include the role of exocytosis of proteolytic enzymes by alveolar cells. One possible means of release of such enzymes is "regurgitative exocytosis", which has been described for a variety of types of leukocytes. Regurgitative exocytosis refers to the coalescence of lysosomal organelles with incompletely formed phagosomes, which results in the release of lysosomal enzymes to the cell exterior. The release of acid phosphatase (p-nitrophenyl-phosphate as the substrate) and elastase (t-butyloxycarbonyl-L-alanine p-nitrophenyl ester as the substrate) by rabbit alveolar macrophages over a 2-hr period during phagocytosis of latex beads (1.1 or 5.7 μm in diameter) or zymosan particles (3 to 5 μm in diameter) was evaluated. Phagocytosis occurred with all particles studied, as indicated by light and scanning and transmission electron microscopy. Release of both enzymes during exposure to 5.7 μm-diameter latex beads showed a linear relationship to the number of particles per cell. On the other hand, no enzyme release occurred during phagocytosis of 1.1-μm-diameter latex beads even when given in equivalent surface area or volume to the 5.7-μm-diameter beads. The amount of enzyme release during exposure to zymosan fell between that for 5 and 10 particles per cell for the larger latex beads. The data imply that the size of the particle is a primarily important determinant of regurgitative exocytosis and that total surface and volume of particles presented to the cell is of secondary importance. This is not necessarily what would be expected on the basis of thermodynamic prediction and could indicate differences in membrane fluidity, based on particle size, which may occur during phagocytosis.

33785 (CONF-760927—, pp 115-140) **Specific metabolic activities of pulmonary endothelial cells.** Ryan, U.S.; Ryan, J.W. (Univ. of Miami School of Medicine). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

The endothelial lining of the pulmonary vascular bed is far more than an inert barrier. Endothelial cells are metabolically active and are capable of processing a wide range of hormones and other excitatory substances, including biogenic amines, adenine nucleotides, and polypeptides. One enzyme of these cells is capable of inactivating bradykinin and of forming angiotensins II and III. These cells must also play at least a passive role in the processing of prostaglandins and related substances. In addition to their specific metabolic activities, pulmonary endothelial cells possess factors active in coagulation and fibrinolysis and may possess enzyme inhibitors, such as α_2-macroglobulin. Although endothelium of other vascular beds has similar or identical properties, the pulmonary endothelium is uniquely situated, between the central venous and systemic arterial circulations, to affect specific functions of the lungs as well as specific functions of distant organs. Thus kinins and some prostaglandins and biogenic amines do not survive passage through the lungs and do not enter systemic arterial blood. In contrast, the pulmonary endothelium is probably a major determinant of the quantities of angiotensins II and III which reach, via the systemic arterial circulation, peripheral organs and glands.

33786 (CONF-760927—, pp 141-148) **Pulmonary endothelial cells: kininase II and other peptide hydrolase enzymes.** Ryan, J.W. (Univ. of Miami School of Medicine); Ryan, U.S.; Chiu, A.T. 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Angiotensin I and bradykinin disappear during a single passage through the pulmonary circulation. These polypeptide hormones are not taken up by the lungs but are hydrolyzed by enzymes on or near the luminal surface of the pulmonary endothelial cells. Kininase II (angiotensin III, a compound even more active than (angiotensin-converting enzyme), a dipeptidyl carboxypeptidase with the capacity of inactivating bradykinin and of converting angiotensin I to its potent lower homolog, angiotensin II, is described in detail. In addition, the enzyme is capable of converting des-Asp--angiotensin I to angiotensin III, a compound even more active than angiotensin II in stimulating the secretion of aldosterone. With immunocytochemical techniques which used antibodies specific for kininase II, the enzyme was found to be situated along the luminal surface of pulmonary endothelial cells in situ and along the plasma membrane of endothelial cells in culture. However, lungs contain other enzymes that are capable of inactivating bradykinin and of metabolizing angiotensin I to yield products other than angiotensin II. These enzymes also appear to be situated on the luminal surface of endothelial cells. Two of the enzymes are capable of removing the N-terminal amino acid residues of bradykinin and angiotensin I. For bradykinin, the removal of the N-terminal residue yields biologically inactive products. However, the removal of the aspartyl residue of angiotensin I yields a precursor of angiotensin III.

33787 (CONF-760927—, pp 181-191) **Respiratory epithelium in the dolphin lung.** Fanning, J.C. (Univ. of Adelaide). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

The respiratory zone of the dolphin lung consists of respiratory bronchi, alveolar ducts and sacs, and alveoli. The respiratory bronchus is generally less than 1 mm in diameter, has cartilage plates in its wall, myo-elastic bundles that form sphincters, and a capillary plexus immediately beneath the epithelium which is composed of cuboidal and squamous cells. The cuboidal cells are found in the gaps in the capillary plexus. They are somewhat flattened, measure up to 10 μm in diameter, and have many short microvilli 0.5 x 0.1 μm on their surface. They contain no inclusions or secretory granules. The capillaries are covered by squamous cells with thin lateral cytoplasmic processes which are only 100 nm thick in some areas. These cells are very similar to the type I cells of the alveoli. The alveoli have a thick connective tissue core with a separate capillary plexus on each surface. The epithelium consists of type I and II cells. The type I cells have very attenuated lateral processes which in some areas are only 30 to 40 nm thick and contain only occasional pinocytotic vesicles in these areas. The type II cells occur in groups of two or three in the intercapillary niches and in the junctional regions of the septum. They contain cytosomes with osmiohpilic lamellae up to 2 μm, microvilli 0.4 x 0.1 μm on their surface, and much folding of the lateral and basal plasma membrane. It is suggested that the respiratory bronchus has evolved as a means of increasing the respiratory surface area during prolonged shallow dives. The blood--air barrier in the alveoli has been reduced to 120 to 200 nm to compensate for the thickness of the septum and for the exposure of the capillaries to only one alveolus.

33788 (CONF-760927—, pp 192-204) **Fine structural observations on the origin and development of lamellar bodies in alveolar type II pneumocytes.** Callas, G.; deGroot, W.J. (Univ. of Texas, Galveston). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Many investigators believe that osmophilic inclusion bodies in type II pneumocytes arise from multivesicular bodies. However, their origin from mitochondria has been suggested by others. From our investigation with euthyroid, hypothyroid, and hyperthyroid animals, we present strong morphologic evidence that lamellar bodies arise from both mitochondria and multivesicular bodies. Transformation figures in mitochondria and multivesicular bodies were observed in all groups of animals but were more numerous and better defined in the hypothyroid animals. In mitochondria, single lamellar structures that are associated with the inner lamina of the mitochondrial membrane appear. In the area of the developing lamellar body, the matrix becomes less dense, and some of the mitochondrial cristae appear to be incorporated into the lamellar inclusion. The lamellar structure then becomes more complex, whereas the cristae disappear.

33789 (CONF-760927—, pp 205-222) **Electron microscopic observations of intracisternal A type particles in a transplantable murine alveolar cell carcinoma with remarks on the cellular origin of this tumor.** Ladman, A.J.; Yuhas, J.M. (Univ. of New Mexico, Albuquerque). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Transmission electron microscopic observations on an alveolar cell carcinoma after in vivo and in vitro transplantation reveal the presence of intracisternal A type (ICA) particles in the endoplasmic reticulum and nuclear envelope. These ICA particles are described, and a sequence of events is reconstructed which considers the origin, growth, and eventual autophagy of these particles by the carcinoma cells. Additional data suggest that the tumor retains structural characteristics of type I and type II epithelial cells as well as the alveolar macrophage. Measurement of surfactant content of the tumor with a Wilhelmi balance supports the morphologic analyses that the tumor produces little or no surfactant as compared to normal lung.

33790 (UCD—472-124, pp 102) **Selective growth of human T lymphocytes in single phase semi-solid culture.** Shen, J.; Wilson, F.D.; Shifrine, M.; Gershwin, M.E. Oct 1977.

In Annual report, fiscal year 1977.

Selective growth and clonal proliferation of human T lymphocytes can be achieved using a single phase semi-solid methylcellulose system without pre-incubation with lectins. However, significant proliferation depends on the continued presence of concanavalin A or photohemagglutinin (but not pokeweed mitogen or lipopolysaccharide) in the methylcellulose. This procedure eliminates nonspecific agglutination by lectins and allows for direct visualization of colonies and their specific removal and subsequent cloning in liquid phase. Optimal growth and production of colonies of greater than 40 cells requires 3 to 9 days. Individual cells can be identified by E rosette formation together with absence of surface immunoglobulin or ability to phagocytize latex particles. Proliferation of peripheral blood T and MOLT-4 cells is inhibited by anti-thymocyte sera but not by anti-B cell sera. Raji cells did not form colonies in this system. Colony formation is not enhanced by the presence of 2-mercaptoethanol. The clonal proliferation of human T lymphocytes has wide application in the study of both antigen recognition and lymphocyte alterations in specific diseases.

33791 (UCD—472-124, pp 103-104) **Cytogenetic studies on bone marrow fibroblasts in humans with hematopoietic disorders.** Greenberg, B.R.; Wilson, F.D.; Klein, A.K.; Dyck, J.A.; Graham, R.; Jones, M. Oct 1977.

In Annual report, fiscal year 1977.

The cytogenetic status of bone marrow stromal elements was determined for five patients with Ph^1-positive chronic myelogenous leukemia (CML) and for one male patient who was successfully treated for aplastic anemia with bone marrow transplantation and who was a demonstrated female-male hematopoietic chimera. The Ph^1 chromosome was absent in fibroblast colonies from the CML patients, and fibroblasts obtained from the chimera were of recipient type. The stromal components associated with CML apparently are not derived from the primary Ph^1-positive malignant clone but represent a stromal reactive component of benign or interdependent malignant potential. The results support previous studies that suggested that the precursors of bone marrow fibroblast colonies are not related closely to hematopoietic elements.

33792 (UCD—472-124, pp 105) **Comparison of whole blood and purified canine lymphocytes in a lymphocyte stimulation microassay.** Shifrine, M.; Taylor, N.J.; Rosenblatt, L.S.; Wilson, F.D.; Wiger, N.; DeRock, E.W. Oct 1977.

In Annual report, fiscal year 1977.

The optimum mitogen concentration and time required for using whole blood from dogs in a microassay was determined. This test then was compared with a standard lymphocyte stimulation micro test using gradient-isolated lymphocytes, two different mitogens [phytohemagglutinin (PHA) and concanavalin A (CON A)] and two different culture media. Statistical analysis of the data from ten dogs showed that whole blood was significantly more reactive than were gradient-isolated lymphocytes ($p < 0.05$). Waymouth's 752/1 medium was significantly better than RPMI media ($p < 0.001$). The interaction between lymphocyte source and mitogens was the only one of the various interactions that was significant ($p < 0.05$).

33793 (UCD—472-124, pp 106-108) **Further studies on canine T-lymphocyte colonies.** Wilson, F.D.; Shifrine, M.; Gershwin, M.E.; Spangler, W.L.; Dyck, J.A.; Whaley, C.B. Oct 1977.

In Annual report, fiscal year 1977.

Cloning of canine lymphocytes by direct plating in methylcellulose allows for colony formation, while eliminating the necessity of presensitization with mitogen, which results in significant clumping. Colonies formed from peripheral blood in response to PHA-P and CON-A have T-lymphocyte characteristics.

33794 (UCD—472-124, pp 116) **Effects of local injection of BCG on colony-forming units in the bone marrow and blood of beagles.** Wilson, F.D.; Shifrine, M.; Chrisp, C.E.; Fidler, I.J.; Klein, A.K.; Dyck, J.A.; Graham, R. Oct 1977.

In Annual report, fiscal year 1977.

The results of preliminary studies on the effects of intramammary gland injection of BCG in normal beagles on hematopoietic, stromal and T-cell progenitors using methylcellulose culture systems

suggest that while bone marrow progenitors for granulocyte-monocyte lines and for T-lymphocytes undergo a transitory reduction "candidate" stromal progenitors were increased in response to BCG injection. In addition, PHA-responsive T-cell progenitors in the blood were reduced temporarily by BCG.

33795 (UCD—472-124, pp 120-121) **Correlation in vitro and in vivo tests for antigen-specific cell mediated immunity in the dog.** Thilsted, J.P.; Shifrine, M.; Wiger, N. Oct 1977.

In Annual report, fiscal year 1977.

Twenty-nine dogs, which had received either BCG, tuberculin-PPD or no immunization, were tested with the three assays simultaneously. The lymphocyte stimulation test (LST) responses showed a definite correlation with the skin test reactions. Only one dog gave an LST response that was higher than expected based on the skin test reaction. In dogs giving skin test reactions below 10/1000 of an inch, LST responses were uniformly low. However, previous studies on the tuberculin skin test in dogs indicate that skin test reactions up to 10/1000 of an inch may be observed in nonimmune dogs, presumably as a result of a mild nonspecific inflammatory reaction. Results of the present study indicate that the LST is a good in vitro correlate of the skin test for delayed-type hypersensitivity.

33796 (UCD—472-124, pp 122-124) **Transfer factor: transfer of cell mediated immunity in the dog.** Thilsted, J.P.; Shifrine, M. Oct 1977.

In Annual report, fiscal year 1977.

Tuberculin sensitivity was transferred from sensitized to nonsensitized dogs with large numbers of viable lymphoid cells. Extracts from similar numbers of sensitized lymphoid cells were not capable of transferring sensitivity or augmenting an existing sensitivity. We conclude that a substance analogous to transfer factor as described in humans does not exist in dogs.

33797 (UCD—472-124, pp 125-126) **Surface markers on canine lymphocytes.** Miller, C.H.; Shifrine, M.; Carbonell, A.; MacKenzie, M.; Wilson, F.D.; Taylor, N.J.; DeRock, E. Oct 1977.

In Annual report, fiscal year 1977.

Canine peripheral blood lymphocytes were stimulated with phytohemagglutinin (PHA), concanavalin A (Con A) or lipopolysaccharide (LPS) mitogens, and E and EAC rosette assays were performed on cells incubated with and without mitogens. In addition, a fluorescent antibody test with anti-canine globulins was used as another B cell marker. The percentage of T-lymphocytes (E rosette) in several hematopoietic tissues from normal dogs ranged from 1 in the thymus to 13 in the peripheral blood. Mean percentages of B-cells ranged from 30 to 40% in the various tissues. The low percentage of T-cells from normal canine tissues, especially the thymus, as compared with values for other animals suggests that the E rosette measures only a sub-population of T-cells. Surface marker values following incubation with LPS, a B-cell mitogen, showed no significant changes, indicating the poor ability of LPS to stimulate canine lymphocytes. Stimulation of cells with the T-cell mitogens, PHA and Con A, produced a two-fold increase in E rosettes and a 50% decrease in the number of EAC rosette-positive cells. In addition these mitogens stimulated a population of T-cells with Fc receptors as evidenced by a marked increase in the number of cells reacting with immune complexes.

33798 (UCD—472-124, pp 131-133) **Characterization of bone marrow cells separated by equilibrium density gradient centrifugation: a preliminary report.** Klein, A.K.; Visser, T.; Wilson, F.D.; Gielow, F. Oct 1977.

In Annual report, fiscal year 1977.

Canine bone marrow progenitors for in vitro clonogenic populations were characterized with techniques of density gradient separation, enzyme histochemistry and phagocytic index. Treatment of canine bone marrow by equilibrium density gradient centrifugation resulted in the production of two fractions containing different types of colony-forming cells. The first fraction was enriched with progenitors of in vitro fibroblastic colonies and the second had a high concentration of progenitors of both granulocyte-monocyte colonies and T-lymphocyte colonies. Density gradient separation provides an excellent tool for further hematological and immunological studies of these progenitors.

33799 (UCD—472-124, pp 135-138) **Immunohematological studies in athymic (nude) mice.** Wilson, F.D.; Shifrine, M.; Gershwin, M.E.; Greenberg, B.R.; Spangler, W.L.; Klein, A.K.; Graham, R.; Dyck, J.A.; Jones, M. Oct 1977.

In Annual report, fiscal year 1977.

Progenitors of granulocyte-monocyte cell lines and "candidate" mesenchymal progenitors in congenitally athymic (nude) mice were quantitated with a methylcellulose-supported culture system. Numbers of both colony types in bone marrow and spleen of nude mice were higher than in their heterozygous normal littermates. In addition, an experimental model system is presented for the investigation of the pathogenetic role of hematopoietic stromal elements in myeloproliferative disorders. Mesenchymal tumors in nude mice were induced by the injection of Ph^1-negative fibroblasts obtained from the bone marrow of a patient with Ph^1-positive chronic myelogenous leukemia. The results also provide the first in vivo morphological and cytogenetic support using human materials of the hypothesized relationship of progenitors of in vitro fibroblastic colonies to marrow stromal elements.

33800 **Cold Spring Harbor symposia on quantitative biology. Volume 41. Part 1. Origins of lymphocyte diversity.** Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977). 459p. (CONF-7606152—P1). 2-part set.

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Separate abstracts were prepared for the 45 papers presented at the conference. (HLW)

33801 **Thymopoietin and bursopoietin: induction signals regulating early lymphocyte differentiation.** Goldstein, G. (Memorial Sloan-Kettering Cancer Center, New York); Scheid, M.; Boyse, E.A.; Brand, A.; Gilmour, D.G. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 5-8(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Studies on polypeptide hormones that induce differentiation of lymphocytes are reviewed under the following headings: inducing agents; the T-cell induction assay; B-cell induction assays; induction assays in the chicken; and origins of lymphocyte diversity. (HLW)

33802 **Normal and neoplastic maturation of T-lineage lymphocytes.** Weissman, I.L. (Stanford Medical School, CA); Baird, S.; Gardner, R.L.; Papaioannou, V.E.; Raschke, W. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 9-21(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Experiments are described and results are presented to demonstrate the following: embryonic hematopoietic origins of the adult hematolymphoid system; analysis of the thymic and T-cell maturation sequence; and specific surface receptors for Mu^2V in T-lymphoma lines. (HLW)

33803 **Regulation of cellular and humoral immune responses by T-cell subclasses.** Cantor, H. (Harvard Medical School, Boston); Boyse, E.A. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 23-32(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Properties of three major T-cell subclasses are discussed with regard to the following: functional properties; production of helper factors; killer function; immunosuppressive activity; role of T-cell subclasses in the response to modified-self; and regulatory effects of H-2 activated T-cell subclasses upon antibody responses. Other topics discussed are a tentative developmental model for generation of self-reactive Te cells and T-cell diversity, and possible mechanisms of T c/s suppression. (HLW)

33804 **Surface markers and functional relationships of cells involved in murine B-lymphocyte differentiation.** Herzenberg, L.A. (Stanford Univ., CA); Herzenberg, L.A.; Black, S.J.; Loken, M.R. Okumura, K.; van der Loo, W.; Osborne, B.A.; Hewgill, D.; Goding, J.W.; Gutman, G.; Warner, N.L. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 33-45(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: cells involved in production of IgG antibody to dinitrophenyl (DNP) hapten; role of helper T cells in differentiation and expansion of memory B cells; suppressor-helper interaction; suppressor T-cell surface markers; surface markers on early B cells; and allelic exclusion for IgM and IgD allotypes. (HLW)

33805 **Unusual kappa immunoglobulin antigen present on the membrane of T and B lymphocytes.** Gottlieb, A.B.; Engelhard, M.; Kunkel, H.G.; Fu, S.M. (Rockefeller Univ., New York). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 47-51(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Several K immunoglobulin antisera out of a large number studied showed the unique property of reacting with a membrane structure present on all T and B lymphocytes examined. This antigen was detected on lymphocytes by indirect fluorescence, direct fluorescence, and by cytotoxic analysis. Absorption of the antiserum by all K myeloma proteins, K Bence-Jones proteins, and k light chains removed the activity; L proteins had no effect. The possibility that the cross-reacting membrane antigen is part of the HL-A system was discussed.

33806 **Hermaphrocyte: a suppressor-helper T cell.** Gershon, R.K.; Eardley, D.D.; Naidorf, K.F.; Ptak, W. (Yale Univ., New Haven). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 85-91(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

From all this data, some circumstantial, some indirect, we offer the following synthesis: As lymphocytes mature either under natural circumstances or via the driving force of antigen, they emit signals which influence other, less mature cells to regulate their response. The less mature cells probably have both Ly-1 and Ly-2,3 antigens on their surfaces. At least part of the signals or information passing between the mature and the immature T cells occurs via the alembic of the macrophage membrane, most likely on regions that have Fc receptor-like characteristics. This last point might imply that the signal itself has some of the characteristics of immunoglobulin. The immature T cell can regulate the response in one of two directions (up or down), and we have thus referred to it as a hermaphrocyte. Whether the regulation occurs by differentiation of an uncommitted Ly-1$^+$, Ly-2,3$^+$ cell into a committed Ly-1$^+$, Ly-2,3$^-$ helper cell and/or by Ly-1$^-$, Ly-2,3$^+$ suppressor cells, or whether the regulating cells retain all of the Ly antigens and act as a distinct third subclass of cell, or both, is presently under examination. The difficulty in deciding between these alternatives has been the difficulty in obtaining purified Ly-1$^+$, Ly-2,3$^+$ cells, since all negative-selection experiments result in the elimination of this cell population. However, experiments with positively selected cells should be possible in the near future and more direct answers to some of the questions we have raised should be forthcoming. Perhaps just as this second Cold Spring Harbor Symposium on the subject of immunology has clarified some of the interesting phenomena reported at the first symposium, we will have some of the answers to the questions we have raised in this paper at the time of the third symposium. Undoubtedly, we will also have new phenomena and new questions to ask and discuss at that time, perhaps in preparation for a fourth symposium. This, in itself, is sort of a network.

33807 Suppressive and enhancing T-cell factors as I-region gene products: properties and the subregion assignment. Tada, T.; Taniguchi, M.; David, C.S. (Chiba Univ., Japan). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 119-127(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

This paper describes two distinct antigen-specific T-cell factors having opposite functions in the regulation of antibody response, one suppressive and the other enhancing for a T-cell-dependent antibody response. Both factors are found to have I-region gene expressions. Available evidence indicates that they are coded for by genes present in distinct I subregions, and that the targets for these factors are probably T cells also carrying I-region determinants. Incorporating the new target cell type in the network of immunocompetent cell interactions, possible mechanisms of T-cell-mediated regulation of antibody response will be discussed.

33808 In vitro studies on the generation of lymphocyte diversity. Owen, J.J.T.; Jordan, R.K.; Robinson, J.H.; Singh, U.; Willcox, H.N.A. (Univ. of Newcastle upon Tyne, Eng.). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 129-137(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: local and systemic factors regulating lymphocytes production; delineation of the diverse sites of lymphocyte maturation; experimental models for the study of local factors in lymphocyte differentiation; hormonal involvement in lymphocyte differentiation; and the functional status of differentiating lymphocytes in various organs. (HLW)

33809 Studies of generation of B-cell diversity in mouse, man, and chicken. Cooper, M.D.; Kearney, J.F.; Lydyard, P.M.; Grossi, C.E.; Lawton, A.R. (Univ. of Alabama, Birmingham). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 139-145(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

We have compared the development of B cells in chickens, mice, and humans, attempting wherever possible to use the differences among them to experimental advantage. Because expression of immunoglobulins at the cell surface occurs earlier in the life history of B cells in chickens, we used them to study generation of diversity of antigen-binding cells (ABC). Studies in mammals have focused on the parallel problem of expression of different immunoglobulin classes. Our studies suggest that clonal diversity is generated sequentially in a programmed manner and first among B cells that express only IgM, and Ig class heterogeneity is developed secondarily by an antigen-independent switch in expression of heavy-chain genes by members of each B-cell clone.

33810 Ontogeny of murine B lymphocytes: development of Ig synthesis and of reactivities to mitogens and to anti-Ig antibodies. Melchers, F. (Basel Inst. for Immunology); Andersson, J.; Phillips, R.A. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 147-158(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The earliest cells synthesizing Ig in the mouse can be detected by biosynthesis incorporation of leucine and by lactoperoxidase-catalyzed radioionation of fetal liver cells, followed by serological precipitation and identification as 7-8S IgM by gel electrophoresis from day 10 to day 12 of gestation onward. These early Ig-synthesizing cells are large; they display their Ig on the surface but release it rapidly ($t_{1/2}$ = 45 min). These cells may be identical with pre-B cells identified by adoptive transfer experiments to be precursors of antigen-reactive B cells. Up to day 15 of gestation, such large precursor B cells are the only detectable Ig-synthetizing B cells in fetal liver. Stimulation of these small B cells by mitogens leads to clonal growth and maturation of plasma blasts and plasma cells secreting 19S IgM, 7S IgG, and IgA at a rapid rate. Fetal liver cells from as early as day 12 to day 13 of gestation will develop, in single-cell suspension cultures, into mitogen-reactive B cells. Such fetal liver cell cultures, in the presence of LPS, develop plaque-forming cells with a peak of IgM response at the equivalent of days 5 to 7 after birth. The time of this peak response is independent of the age of fetal liver at which the cultures are initiated. LPS can be added to the cultures as late as the equivalent of day 18 or 19 of gestation without changing the size or the kinetics of the PFC response. This indicates that B cells from fetal liver acquire LPS reactivity at around birth either in vitro or in vivo.

33811 Development and modulation of B lymphocytes: studies on newly formed B cells and their putative precursors in the hemopoietic tissues of mice. Raff, M.C. (University Coll., London). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 159-162(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: hemopoietic tissues as the mammalian bursa-equivalent; modulation of surface IgM; relevance for B-cell tolerance to self; and properties of presumptive pre-B cells. (HLW)

33812 Induction of immunoglobulin synthesis in Abselon murine leukemia virus-transformed mouse lymphoma cells in culture. Weimann, B.J. (Basel Inst. for Immunology). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 163-164(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

It is shown that addition of dimethyl sulfoxide (DMSO) to A-MuLV-transformed tissue-culture cells stimulates their differentiation and results in the production of immunoglobulins. The induction of B lymphoid differentiation may be compared with the effect of DMSO shown on Friend virus-transformed erythroleukemic cells in culture. From these results it is concluded that DMSO induces A-MuLV-transformed cells to synthesize IgM molecules which are eventually deposited on the cell surface and to synthesize a so far unidentified protein which binds to immune complexes. The induced state of differentiation may be either that of the small B lymphocyte, which synthesizes and inserts monomeric IgM into the cell membrane but does not secrete it (Melchers and Andersson 1973), or that of a precursor to the small resting B cell, which synthesizes monomeric IgM and probably also inserts it into the surface membrane, though with higher turnover rates.

33813 Immunoglobulin receptors on murine B lymphocytes. Vitetta, E.S.; Cambier, J.; Forman, J.; Kettman, J.R.; Yuan, D.; Uhr, J.W. (Univ. of Texas, Dallas). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 185-191(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Two major points have emerged from our recent studies: first, two new stages in B-cell differentiation have been described, that is, we have placed the cell bearing IgM and IgD and the cell bearing only IgD as successive stages between an earlier cell bearing only IgM and a later one bearing IgG (and possibly also IgD). It should be emphasized, however, that formal proof that these are successive stages of a single B-cell lineage is lacking. Second, the biologic reactivity of these different cell types differs in several important respects, e.g., neonatal B cells are exquisitely sensitive to induction of tolerance as compared to adult B cells, and LPS stimulates a different response in IgM$^+$ versus IgM$^-$ B cells. Whether these different biologic functions are caused by the different biological reactivities of the respective isotypes or by other cell-surface or metabolic differences is not known. However, these possibilities should be testable in in vitro models, most particularly since the recent availability of anti-mouse delta. Hopefully, such approaches will eventually answer the questions of the function of IgD, the roles played by IgM and IgD on the same cell, and the predominance of these two isotypes in B-cell populations.

33814 Mechanism of B-cell activation and self-non-self discrimination. Moeller, G. (Karolinska Inst., Stockholm). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 217-226(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The evidence for the one, nonspecific signal hypothesis, which states that the B lymphocytes are activated by nonclonally distributed receptors which are not the Ig receptors, has been summarized. Even though protein A is a polyclonal B-cell activator, it does not exert its effect by interacting with the Fc part of Ig receptors. One consequence of the one, nonspecific signal concept is that thymus-dependent antigens cannot activate or tolerize B cells. It was shown that B cells from animals tolerant to a thymus-dependent protein antigen could be activated by polyclonal B-cell activators to produce antibodies against the tolerogen. Experimentally induced tolerance did not differ from tolerance to self antigens, since LPS and PPD induced autoantibodies capable of lysing autologous red cells and isotope-labeled autologous and syngenic spleen cells. Thus B cells cannot discriminate self from non-self, whereas T cells have been shown to possess this ability.

33815 Growth and maturation of single clones of normal murine T and B lymphocytes in vitro. Andersson, J. (Uppsala Univ.); Coutinho, A.; Melchers, F.; Watanabe, T. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 227-236(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Normal murine T and B lymphocytes can be stimulated by defined mitogens to divide in suspension cultures and in semisolid agar. Exponential growth with division time around 18 hours can be maintained for weeks at low cell densities in regularly renewed medium containing 2-mercaptoethanol, a growth-supporting fetal calf serum, and a lymphocyte mitogen. Removal of the mitogen results in growth arrest and reversion to small resting cells, which can be restimulated to grow upon readdition of the mitogen. In semisolid agar, clones of T and B cells grow with cloning efficiencies around 1 in 10^3 plated cells. The frequency of growing cells appears higher in suspension culture, where cells settle to the bottom. The frequency of growth-initiating lymphocytes appears dependent on the surface area of the culture dish on which the cells settle. It may therefore be dependent on cell-to-cell contact. Addition of inert thymus cells as fillers increases the frequency of LPS-responsive, growing B cells to 1 in 6 spleen cells, i.e., 1 in 3 spleen B cells, as determined in a limiting dilution assay. Within a growing clone of B cells, practically all cells secrete Ig and form a direct hemolytic plaque at day 4 or 5 in culture where the clone has reached a size of 32 or 64 cells, respectively. With the same culture conditions, frequencies of precursors for antibody-secreting B cells are 1 in 2300 for sheep red cells, 1 in 50 for TNP_{30}-SRC, and 1 in 10 for NIP_{12}-SRC. Mitogenic stimulation of B cells also leads to maturation into IgG- and IgA-secreting cells. This "switch" to IgG and IgA secretion appears independent of macrophages and mature T cells.

33816 Hapten-specific B lymphocytes, enrichment, cloning, receptor analysis, and tolerance induction. Nossal, G.J.V.; Pike, B.L.; Stocker, J.W.; Layton, J.E.; Goding, J.W. (Walter and Eliza Hall Inst. of Medical Research, Melbourne). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 237-243(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

In this paper, we review experiments verifying clonal selection through the use of hapten-fractionated B lymphocytes of such uniformity that up to one cell in three can be induced to form an anti-hapten antibody-forming clone in vitro; the use of such cells in studies on antigen-induced receptor aggregation and modulation using immunogenic or tolerogenic antigen concentrations; application to the tolerance problem of the cloning methods devised for the study of these cells; studies of the IgM- and IgD-like receptors of hapten-specific cells; and the use of an anti-delta allotype serum to study the distribution and function of IgD-like molecules on the B-lymphocyte surface.

33817 Regulation of clonal B-lymphocyte proliferation by anti-immunoglobulin or anti-Ia antibodies. Kincade, P.W.; Ralph, P. (Sloan-Kettering Inst. for Cancer Research, Rye, NY). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 245-250(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Regulatory effects of antibodies to cell-surface antigens have been examined in an in vitro clonal assay for B lymphocytes. In this system, cell contact is prevented by a semisolid gel matrix, and many of the factors affecting cell proliferation have been described. Inclusion of antibodies to μ, kappa, or Ia in these cultures reduced the size and number of proliferating foci. As little as 1 μg/ml of anti-μ antibody prevented formation of colony-size aggregates. Pretreatment with these antibodies before culture followed by a wash had no effect. Divalent $F(ab')_2$ anti-IgM antibodies were as effective as intact antibodies, but monovalent Fab fragments were not inhibitory. Anti-γ_1 antibodies, anti-α antibodies, or cell-bound antigen-antibody complexes had no effect on clonal proliferation. These findings suggest that a negative signal can be delivered to B cells during a critical period of their activation via certain surface receptors. Modifications in culture conditions result in the selective propagation of different B-cell subpopulations.

33818 Cellular and molecular interactions in control of B-cell immunity and tolerance. Diener, E.; Shiozawa, C.; Singh, B.; Lee, K.C. (Univ. of Alberta, Edmonton). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 251-259(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The antibody response of mouse spleen cells in vitro to three thymus-independent antigens [polymerized flagellin (POL), haptenated Ficoll, and soluble sheep erythrocyte antigen] was found to be dependent on adherent radioresistant (A) cells. The fundamental importance of A cells in the regulation of B-cell immunity and tolerance was emphasized by showing that normal A cells could restore the POL response in specifically tolerant spleen cells. "Tolerant" A cells were incapable of such restoration. Since tolerance to POL is antigen-specific, we conclude that "tolerant" A cells must also be specifically unresponsive. We postulate that A cells cooperate with B cells by means of a cellular product in association with antigen, hence the apparent specificity of A-cell cooperation. Earlier work (Diener and Feldmann, 1971) had shown that the reversibility of tolerance by transfer of tolerant spleen cells to irradiated recipients could be achieved only within the first 2 to 3 days of induction. This, together with the present data, suggests that the induction of irreversible tolerance requires two steps: first, the elimination by antigen of the A-cell cooperative response, and second, the induction of unresponsiveness in B cells, which requires a period of 2 to 3 days. We have also analyzed the molecular requirements at the B-cell surface which determine the in vitro triggering of antibody responses to thymus-dependent antigens. Carrier-specific thymus-cell-derived helper factor was shown to be necessary for the induction of a primary IgM antibody response to trinitophenylated rabbit gamma globulin and bovine serum albumin.

33819 Antigen-binding, idiotypic receptors from T lymphocytes: an analysis of their biochemistry, genetics, and use as immunogens to produce specific immune tolerance. Binz, H.; Wigzell, W. (Uppsala Univ.). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 275-284(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Data are presented on the use of the naturally occurring idiotypic receptors with specificity for histocompatibility antigens as specific autoimmunogens. The results show that, at least within certain strain combinations, it is possible to use naturally occurring antibodies as specific antigens to provoke an autoimmune reaction leading to specific immune tolerance. This immunity (causing tolerance) has so far had no negative side effects of objectionable nature, and the tolerance seems to be long-lived. Besides the practical possibilities of applying such an approach in clinical situations (contact eczemas, transplantation immunity, maybe even certain autoimmune disorders are conditions to be considered), the present findings add further weight to the notion of the immune system as a network where cells, antibodies, antigens, and anti-antibodies with positive and negative signals collaborate in an intricate, cybernetic manner. The exact outcome of any given manipulation in such a system may sometimes be predictable according to the immunologist, but although results and predictions may go together, the complicated underlying processes may make such parallel events highly fortuitous.

33820 Structure of the T-cell receptor for antigen. Krawinkel, U.; Cramer, M.; Berek, C.; Haemmerling, G.; Black, S.J.; Rajewsky, K.; Eichmann, K. (Univ., Cologne). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 285-294(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Antigen-binding receptors of T lymphocytes were analyzed in two different ways. First, the idiotypic properties of T helper cells are studied using anti-idiotypic antisera prepared against isolated antibodies specific for A-CHO. These anti-idiotypic antisera are defined by immunogenetic and immunochemical means with respect to their reactivity with heavy- or light-chain associated idiotypic determinants. Second, antigen binding receptors are isolated from enriched T- and B-lymphocyte preparations and compared with respect to their reactivity with antigen and with class- or allotype-specific anti-Ig antisera. The results provide an incomplete picture of the T-cell receptor which shares with antibodies the variable region of the heavy chain but probably no other variable or constant portion.

33821 Functional characterization of rabbit lymphocytes carrying Fc receptor. Cazenave, P.A.; Juy, D.; Bona, C. (Institut Pasteur, Paris). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 307-314(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

In rabbit spleen, among the 30% of lymphoid cells carrying Fc receptors, 8.7% contain immunoglobulin. Both types of cells, $Fc^+ Ig^+$ and $Fc^+ Ig^-$, proliferate subsequent to stimulation by a rabbit

B-cell mitogen (i.e., Nocardia water-soluble mitogen). In certain cases, this stimulation runs in parallel with an increase in antibody-dependent, cell-mediated cytotoxicity (ADCMC). Anti-a3 and anti-b4 antiallotypic immune sera, as well as anti-rabbit IgG immune serum, enhanced the ADCMC in a system in which rabbit anti-ChRBC antibody ($a3^+$, $b4^+$) coated the target cells and rabbit lymphocytes ($a3^+$, $b4^+$) were used as effector cells. This enhancement cannot be attributed to lymphocyte proliferation induced by antiallotypic and anti-Ig antibody but is more likely related to the formation of an additional bridge between effector and target cells. This was clearly demonstrated by the fact that a bridge produced by rabbit $F(ab')_2$ fragments of anti-b4 antibody between target cells coated with rabbit $b4^+$ Fab fragments of anti-ChRBC Ig and Ig receptor of effector cells elicited a smaller but significant cytotoxic effect.

33822 Structure of HL-A A and B antigens isolated from cultured human lymphocytes. Strominger, J.L. (Harvard Univ., Cambridge, MA); Mann, D.L.; Parham, P.; Robb, R.; Springer, T.; Terhorst, C. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 323-329(1977).

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A model was prepared which summarizes schematically our present knowledge of the structure and orientation of the HL-A antigenic molecule in the lymphocyte membrane (Fig. 3). It seems likely that the heavy chain spans the membrane, with the hydrophobic region inserted in the membrane and the hydrophilic C-terminus inside the cell. This C-terminal region bears one (possibly two) SH residue which has the potential for forming interchain disulfides. Whether or not these are actually formed physiologically remains an interesting question. There is the attractive possibility that whatever the physiological functions of HL-A antigens are, structurally these molecules provide the potential for signaling from outside the cell to inside the cell because they span the membrane. It is even conceivable that this function might be expressed via the opening and closing of disulfide bridges.

33823 Genetic restriction in T-lymphocyte activation by antigen-pulsed peritoneal exudate cells. Paul, W.E.; Shevach, E.M.; Thomas, D.W.; Pickeral, S.F.; Rosenthal, A.S. (National Inst. of Allergy and Infectious Diseases, Bethesda, MD). pp 571-578 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

According to the cellular interaction (CI) theory, in its simplest form, T lymphocytes from (2 x 13)F_1 donors primed to an antigen such as ovalbumin (OA) should contain one set of antigen-responsive T lymphocytes which should respond both to OA-pulsed strain-2 peritoneal exudate cells (PEC) and to OA-pulsed strain-13 PEC. This prediction is based on the independence of the OA-binding receptor of the T lymphocyte and of the CI gene product and on the expression of both allelic forms of CI genes in all cells. The compound antigenic determinant (CAD) hypothesis would predict that OA-responsive T lymphocytes of primed (2 x 13)F_1 donors should consist of two subsets of cells, one initially stimulated by a CAD based on strain-2 Ia antigens and the other by a determinant based on strain-13 Ia antigens. Thus one set of these F_1 T lymphocytes should respond to OA-pulsed strain 2 PEC but not to OA-pulsed strain 13 PEC, whereas the other set should have the opposite responsiveness pattern. This paper reports studies which examine this question. T lymphocytes purified from peritoneal exudates of immunized (2 x 13)F_1 guinea pigs were subjected to both negative- and positive-selection techniques using antigen-pulsed parental PEC as the selecting agent. The remaining cells were then tested for their ability to respond both to the antigen-pulsed PEC used as the selecting agent and to antigen-pulsed PEC obtained from the alternative parent. Results indicate that two independent populations of antigen-specific T lymphocytes exist in primed F_1 guinea pigs, one responsive to antigen-pulsed PEC of strain-2 guinea pigs and the other to antigen-pulsed PEC of strain-13 guinea pigs.

33824 Antigen activation of T lymphocytes: influence of major histocompatibility complex. Miller, J.F.A.P.; Vadas, M.A. (Royal Melbourne Hospital). pp 579-588 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

There is considerable evidence that T-cell activation to soluble antigens occurs only if this is processed by macrophages and displayed appropriately on the cell membrane in association with products of the genes of the MHC. The genes responsible differ according to the cells and antigens involved. For cytotoxicity, targets and killer T cells must share K- or D-region gene products. For delayed-type hypersensitivity to FGG in mice, I-A identity is necessary; for DNFB, identity at either the I, K, or D region is sufficient. Experiments using three different approaches do not support the notion that these genetic constraints are due to the necessity for the T cell and stimulator cell to match an identical gene product or cell-interaction molecule. Rather, they favor the hypothesis that there are receptors on the activated T cells which recognize antigen and products of genes of the MHC. The implications of the results are discussed in terms of different T-cell subsets, the mode of action of Ir genes, and the possible parallel evolution of T-cell receptors for antigen and gene products of the MHC.

33825 Regulatory mechanisms in the immune response to cell-surface antigens. Lake, P.; Mitchison, N.A. (University Coll., London). pp 589-595 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The role of associative recognition has been evaluated in the adoptive secondary antibody response to antigens of the major histocompatibility complex of the mouse, H-2, and a representative minor alloantigen, Thy-1. Immunization between normal inbred strains appears to generate T/sub H/ cells directed at components of H-2. So long as these were present, no contribution to the anti-H-2 response could be detected from T/sub H/ cells directed at minor antigens. Moreover, in a limited study employing the A-strain recombination, no contribution to the anti-H-2D response could be detected from H-2K, I-A, or I-B. If, however, the T/sub H/ cells directed at H-2 components are eliminated, the anti-H-2 response can be helped by T/sub H/ cells directed at minor antigens. This provides a formal demonstration of intermolecular, intrastructural help. In the response to Thy-1, H-2 antigens exert a suppressive effect apparently mediated by intermolecular, intrastructural competition. Like the helper effect from minor antigens to H-2, this indicates that separate molecules on the cell surface are coprocessed in the immune system.

33826 Significance of T—B collaboration across haplotype barriers. Swain, S.L.; Trefts, P.E.; Tse, H.Y.S.; Dutton, R.W. (Univ. of California, San Diego, La Jolla). pp 597-609 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

In some models it can be argued that collaboration occurs because antigen is presented on allogenic cells during priming or, in other models, that the responses are due to positive allogenic effects. We therefore set out to characterize the negative allogenic effects, devise ways to eliminate these effects, and determine whether collaboration could be observed across haplotype barriers under conditions where positive allogenic effects could be excluded as the reason for the apparent collaboration. In these experiments, we have used the secondary in vitro anti-hapten response seen when carrier-primed T cells are incubated with hapten-primed B cells. In this model, the primed allogenic T cells confront the B cells for the first time at the moment that they are required to collaborate. The results to be reported lead us to conclude that collaboration can be observed across haplotype barriers when negative allogenic effects are minimized and that the responses obtained are not due to positive allogenic effects.

33827 Role of the histocompatibility gene complex in lymphocyte differentiation. Katz, D.H. (Harvard Medical School, Boston). pp 611-624 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The following topics are discussed: evidence for the role of major histocompatibility complex (MHC) gene products in the cell-cell interactions; the basis for the altered-self model of T-cell recognition; interaction of histo-incompatible T and B cells in cooperative immune responses; role of suppression phenomena in the failure of histocompatible T and B cells to interact in secondary Ig G responses; and the concept of adaptive differentiation. (HLW)

33828 Comparison of B-cell activation factors. Klein, J. (Univ. of Texas, Dallas). pp 625-626 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The differentiation of a B lymphocyte toward an IgG antibody-producing plasma cell is a complex process which can be triggered by a number of stimuli. One group of such stimuli is

comprised of B-cell activation factors, or simply factors, which are soluble substances that are released by other cells (T lymphocytes, macrophages, or perhaps even other B lymphocytes) and act directly or indirectly on B lymphocytes. A great number of B-cell activation factors have been described by different laboratories, but no attempt has been made to compare them and to determine their relationships. As reported elsewhere in this volume, another such factor has been described by McDevitt et al. The presentation by McDevitt at the meeting inspired a discussion among other investigators present in which they compared the properties of their factors to those of the Delovitch-McDevitt factor. As a result of this discussion, a chart was prepared.

33829 Idiotypes and anti-idiotypes as probes in analysis of immunoregulation. Cosenza, H.; Augustin, A.A.; Julius, M.H. (Basel Inst. of Immunology). pp 709-718 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Our main interest has been to use idiotypes and anti-idiotypes as probes for analyzing the antibody response of BALB/c mice to phosphorylcholine (PC). This response is quite exceptional in that the antibodies produced to PC are of restricted avidity and bear the same idiotype, one identical with that of the TEPC-15 (T15) BALB/c myeloma which also binds PC. Taking advantage of this idiotypic homogeneity, we have been able to modulate the response to PC by suppressing the T15 idiotype with anti-idiotypic antibodies, demonstrate the specific recognition of autologous T15 idiotype by both bone-marrow (B)-derived and thymus (T)-derived cells, and investigate if both B and T cells specific for PC share the T15 idiotype. These results are considered in the context of humoral and cellular interactions which might be involved in the regulation of the immune response to PC.

33830 Immune responses of BALB/c mice to the idiotype of T15 and of other myeloma proteins of BALB/c origin: implications for an immune network and antibody multispecificity. Sakato, N. (Massachusetts Inst. of Tech., Cambridge); Janeway, C.A. Jr.; Eisen, H.N. pp 719-724 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Normal adult BALB/c mice are virtually unresponsive to the idiotype of myeloma protein T15 when immunized with purified T15. However, antibodies to the T15 idiotype can be elicited by T15 in BALB/c mice that are reared in a germ-free environment or injected as newborns with an alloantiserum to the idiotype. Some germ-free and neonatally suppressed mice also produce helper cells (presumably T helpers) that enhance B-cell production of anti-DNP antibodies in response to DNP-T15. Taken together with previous studies, the present results mean that so far there are no exceptions to the rule that BALB/c mice have B and T cells that can respond to idiotypes of myeloma proteins of BALB/c origin. There appears to be a reciprocal relation between the natural prevalence of an immunoglobulin's idiotype and its immunogenicity in isologous individuals. The findings support proposals for an immune network of idiotypes and anti-idiotypes. Besides binding one or more extrinsic antigens, it is likely that each immunoglobulin also binds the idiotype of some other immunoglobulin. An immune network therefore implies multispecificity of antibodies.

33831 Life style of B cells: cellular proliferation and the invariancy of IgG. Askonas, B.A.; North, J.R. (National Inst. for Medical Research, London). pp 749-759 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

We have studied in a number of systems the induction of high levels of IgG production and secretion in vitro in mouse spleen cells: IgG stimulation by E. coli lipopolysaccharide in longterm, high-density or shorter-term, low-density cultures. IgG formation was quantitated by pulsing cells with radioactive amino acid. Stimulation of IgG PFC by a T-dependent hapten-carrier protein in a 5-day Mishell-Dutton culture. High antibody responses required that donor mice be boosted after priming, but the anti-DNP response in vitro remained entirely dependent on proliferation, antigen, and T-cell help. All our results indicate that many proliferative cycles of Ig-bearing cells are obligatory before maturation into IgG-secreting cells can occur.

33832 Evolution in microcosm: the rapid somatic diversification of lymphocytes. Cunningham, A.J. (Australian National Univ., Canberra). pp 761-770 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The characteristic task of the immune system is learning to respond specifically to entirely novel antigens. Vertebrate and invertebrate immune strategies are contrasted. Whereas among invertebrates whole individuals appear to be selected for their immunological fitness, vertebrates have developed an internal population of lymphocytes among which variants arise and are selectively stimulated by antigen to give a response which protects the host. The genetic mechanism underlying this variation of lymphocytes is of great interest, but its discovery will not, given present ignorance of eukaryote DNA, answer those questions about variation at the phenotypic level that are vital to the rest of immunology, e.g., when, how fast, and under what conditions do variants arise. A great deal of indirect evidence suggests that the production of entirely new variant lymphocytes occurs throughout life, particularly after antigenic stimulation. Experimental approaches are discussed which might provide direct evidence for or against the idea of rapid variation among stimulated lymphocytes. The method used was based on detecting the cross-reactive specificity of antibody produced by single cells. Evidence obtained with this technique is described briefly.

33833 Polymorphic B-cell determinants in man. van Rood, J.J.; van Leeuwen, A.; Jonker, M.; Termijtelen, A.; Bradley, B.A. (University Hospital, Leiden). pp 417-427 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

A general outline of the knowledge about genetics of the HL-A system is presented and recent findings concerning HL-A coded determinants recognized by the mixed lymphocyte culture (MLC) test or variants are discussed. A summary is presented of studies on determinants coded for loci in the HL-A region which express themselves best on the B cells and monocytes, the B-cell antigens. (HLW)

TRACER TECHNIQUES

33834 (CONF-760927—, pp 106-114) **Cytokinetic study of alveolar macrophage renewal in rats.** Masse, R.; Fritsch, P.; Nolibe, D.; Lafuma, J.; Cretien, J. (Commissariat a l'Energie Atomique, Montrouge Cedex, France). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Pools of alveolar macrophages and monocytes were measured by combining morphometry and the extraction of cells by lavage. The turnover rate of macrophages was evaluated by measuring the clearance rate of $^{59}Fe_2O_3$ previously administered by aerosols. The labeling index and S phase duration of cells in alveoli and lung capillaries were determined by autoradiography after ^{3}H-labeled thymidine and 5-^{125}Iododeoxyuridine incorporation. The disappearance rate was determined after specific incorporation of ^{125}Iododeoxyuridine in deoxyribonuclease (DNA) of alveolar macrophages. Steady-state parameters are presented. Under healthy conditions there are almost no macrophages in the interstitium space. Lung capillaries must be considered as a maturation compartment for macrophages before the last dividing stage in the alveoli. This is consistent with the large enrichment of monocytes in the lung and the ability of some of these monocytes to divide inside the capillaries.

33835 (UCD—472-124, pp 97-99) **Bone marrow cellularity.** Stitzel, K.A.; Wilson, F.D.; Jones, M.; Bristow, S.; Hogue, R. Oct 1977.

In Annual report, fiscal year 1977.

A technique has been devised using ^{59}Fe labeling to determine bone marrow cellularity in the canine. Data is presented on normal beagles of various ages. The results show a significant decrease in cellularity with age in the tibiae, ulnae, and femora.

GENETICS

REFER ALSO TO CITATION(S) 33769, 33791, 33832, 33872, 33877, 33878, 33879, 33880, 33881, 33882, 33883, 33884, 33885, 33886, 33891, 33892, 33893, 33894, 33895, 33896, 33897, 33898, 33899, 33900, 33901, 33902, 33903, 33904, 33905

33836 Fertility and mating performance of interspecific crosses between Heliothis virescens and H. subflexa backcrossed for three generations to H. subflexa. Karpenko, C.P.; Proshold, F.I. (Agricul-

tural Research Service, Fargo, ND). *Ann. Entomol. Soc. Am.;* **70**: No. 5, 737-740(15 Sep 1977).

Hybrids were produced from interspecific crosses between Heliothis virescens (F.) and H. subflexa (Guenee), and backcross progeny (BC) were obtained by crossing hybrid females with H. subflexa males. The reproductive capacity of BC_1 and BC_2 adults was determined by crossing both males and females with H. virescens and H. subflexa. The BC_1 and BC_2 females were partially to fully fertile; the BC_1 males were mostly sterile. Females crossed with BC_1 males seldom received eupyrene sperm in their spermathecae. Females mated with BC_2 males received eupyrene sperm more frequently and the eggs they laid had a higher percentage hatchability than those laid by females crossed with BC_1 males. This recovery of fertility in BC_2 males was not dependent upon type of interspecific cross or upon species of female.

33837 Synthesis of multiple immunoglobulin classes by single lymphocytes. Pernis, B.; Forni L.; Luzzati, A.L. (Basel Inst. of Immunology). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 175-183(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Studies were conducted on the genetic control of immunoglobulin synthesis using human peripheral blood lymphocytes and mouse and rabbit spleen and lymph node lymphocytes. Tables are presented to show simultaneous presence of IgM and IgG in rabbit plasma cells, early appearance of surface IgG on LPS-stimulated mouse spleen lymphocytes, effect of antiserum on the expression of membrane immunoglobulins in the presence of LPS; and IgM- and IgG-containing cells in LPS-stimulated mouse spleen cultures. Experiments on the simultaneous presence of IgM and IgG in single cells from LPS-stimulated cultures indicated that these cells appear very early after stimulation and that they persist for 4 to 5 days before they mature to cells that secrete only one class. (HLW)

33838 Genetics and serology of HL-A-linked human Ia antigens. Barnstable, C.J. (Oxford Univ.); Jones, E.A.; Bodmer, W.F.; Bodmer, J.G.; Arce-Gomez, B.; Snary, D.; Crumpton, M.J. pp 443-455 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

This paper reviews work on the definition of the human Ia antigens. Since these antigens are expressed on peripheral blood B lymphocytes and monocytes, but not on most T lymphocytes, serological analysis must depend either on separating the reactive subpopulations or on using alternative sources of cells which are primarily B cells. We have used B-cell-derived lymphoid lines, transformed in vitro by Epstein-Barr virus (EBV), to define Ia specificities based on patterns of serological reactions with sera from multiparous women. Partially purified Ia antigens recognized by these sera were used to raise an antiserum in rabbits, which, in turn, has been used to extend our studies of the tissue distribution and genetics of the Ia antigens using somatic cell hybrids.

33839 Genetic control of specific immune responses and immune suppressions by I-region genes. Benacerraf, B.; Dorf, M.E. (Harvard Medical School, Boston). pp 465-475 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The following topics are discussed: influence of immune response (Ir) genes on the complex interactions between antigens and the various cell types concerned collectively with the development of specific immunity; complementing specific immune suppressor genes; and stimulation of helper and suppressor activities by different determinants on the same molecule. (HLW)

33840 Concept that surveillance of self is mediated via the same set of genes that determines recognition of allogenic cells. Zinkernagel, R.M. (Scripps Clinic and Research Foundation, La Jolla, CA); Doherty, P.C. pp 505-510 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The following topics are discussed: the basic model for genes that determine recognition of allogeneic cells; evidence for recognition of an invariant structure; self-recognitive V genes in the response to different viruses; generation of different clones of virus-immune T cells in mouse chimeras; and immunological surveillance by T cells. (HLW)

33841 Model-building studies of antigen-binding sites: the Hapten-binding site of MOPC-315. Padlan, E.A. (National Institutes of Health, Bethesda, MD); Davies, D.R.; Pecht, I.; Givol, D.; Wright, C. pp 627-637 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

In this paper, we describe the results of two independent attempts to construct the model of MOPC-315, one at the National Institutes of Health and the other at the Weizmann Institute. The two models were ultimately merged to give a final model that is presented and is discussed in terms of the known binding specificity, the kinetic mapping of the binding site, and the results of affinity labeling with various reagents. We discuss some of the limitations and the potential of this method of model building, the assumptions that have to be made, and some of the additional information that will be needed to put this tentative approach on a firmer footing.

33842 V-region genes for rabbit Ig heavy chains. Knight, K.L.; Horng, W.J.; Dray, S. (Univ. of Illinois, Chicago). pp 687-688 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The variable regions of rabbit immunoglobulin (Ig) heavy chains are controlled by three separate but closely linked loci, a, x, and y (V/sub H/a, V/sub H/x, and V/sub H/y). The first of these loci to be identified was V/sub H/a, which has three alleles, a, a^2, and a^3. The allotypic specificities a1, a2, and a3, controlled by the V/sub H/a locus, are found on 65—90 percent of Ig molecules in normal sera. The remaining 10—35 percent of Ig molecules have often been designated "a-negative" molecules. Alloantisera raised against these a-negative molecules identified two additional allotypic specificities x32 and y33. These specificities, as well as the V/sub H/a specificities, reside on separate molecules. Genetic studies showed that x32 and y33 were controlled by genes x^{32} and y^{33}, which are closely linked to each other and to the V/sub H/a locus. Since the x32 and y33 specificities are found on IgG, IgA, and IgM and since the genes are closely linked to V/sub H/a, it appears that the x32 and y33 specificities reside on V/sub H/. Thus the chromosomal region for heavy chains in rabbit must include three separate V-region genes, V/sub H/a, V/sub H/x, and V/sub H/y.

33843 Identical hypervariable regions in light chains of differing V/sub k/ subgroups. Capra, J.D.; Klapper, D.G.; Tung, A.S.; Nisonoff, A. (Univ. of Texas, Dallas). pp 847-853 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

A discussion is presented of the two major theories of antibody diversity, the germ-line or multigene theory, and the paucigene or somatic theory. Recent data for and against each of these theories are summarized. Structural studies on antibodies are described and a diagram is presented to show aminoacid sequence of the idiotype anti-Ar antibodies. (HLW)

METABOLISM

REFER ALSO TO CITATION(S) 33766, 33779, 33785, 33786, 33800, 33807, 33865, 33868, 33971, 33984, 34023

33844 (UCD—472-124, pp 165-166) **Thyroid gland weights of guinea pigs.** Book, S.A.; McNeill, D.A. Oct 1977.

In Annual report, fiscal year 1977.

Thyroid glands of guinea pigs weighed from 10 to 20 mg in late gestation, increasing to around 100 mg by 6 months of age. Thyroids were about 0.02 to 0.05% of the total body weight in late gestation and 0.01 to 0.02% at 7 months.

33845 Nidifocene: a reassignment of structure. Waraszkiewicz, S.M. (Clark Univ., Worcester, MA); Erickson, K.L.; Finer, J.; Clardy, J. *Tetrahedron Lett.;* No. 27, 2311-2314(1977).

Results of a definitive x-ray structural study of nidifocene, a major metabolite of the Hawaiian marine alga Laurencia nidifica, are presented. The final structure proposed is one in which the chlorine is attached to the tertiary center and the bromine to the secondary carbon. The ring containing the halogens is in a twist boat configuration. (BLM)

MEDICINE

33846 (ORNL/BCTIC—2) **Review of information processing in medical imaging. Proceedings of fifth international conference, Nashville, Tennessee, June 27—July 1, 1977.** Brill, A.B.; Price, R.R.; McClain, W.J.; Landay, M.W. (comps.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1978. Contract W-7405-ENG-26. 663p. (CONF-770685—). Dep. NTIS, PC A99/MF A01.

From 5. international conference on information processing in medical imaging; Nashville, TN, USA (27 Jun 1977).

Forty-three papers discuss methods for improvement of the images from radionuclide scans and radiographs for diagnostic purposes. Abstracts of three papers have appeared previously in ERA.

33847 **Postfertilization development in Clathromorphum, Melobesia, and Mesophyllum with comments on the evolution of the Corallinaceae and the Cryptonemiales (Rhodophyta).** Lebednik, P.A. (Univ. of California, Berkeley). *Phycologia;* **16**: No. 4, 379-406(Dec 1977).

The history of classification of the Corallinaceae and the nomenclature of suprageneric taxa in the family are reviewed. The formation of connecting filaments and the presence of an auxiliary complex at the periphery of the female disc are demonstrated in Clathromorphum, Melobesia and Mesophyllum. It is postulated that the progenitor of the Corallinaceae formed conceptacles in which all disc filaments developed receptive carpogonia and post-fertilization development was procarpial. The evolution of the Corallinaceae is hypothesized as involving a gradual reduction of peripheral carpogonial branch systems and a change in the site of initiation of carposporangia from fertilized to unfertilized carpogonial branch systems, resulting in a non-procarpial condition. It is hypothesized that the families of the Cryptonemiales can be grouped into three lines of evolution: the fertile axial line (e.g. Cryptonemiaceae), the scattered polycarpogonial line (e.g. Kallymeniaceae) and the condensed polycarpogonial line (e.g. Corallinaceae). The progenitors of the fertile axial line probably lacked auxiliary cells whereas the progenitors of the two other lines were probably procarpial. Evolution of these progenitors is hypothesized as involving the growth of filaments and change in site of initiation of carposporangia from fertilized to unfertilized (and subsequently reduced) carpogonial branch systems. These results indicate that the non-procarpial condition in the polycarpogonial lines evolved from the procarpial condition and that nutritive auxiliary cells evolved from generative auxiliary cells.

TRACER TECHNIQUES

REFER ALSO TO CITATION(S) 33846

33848 **Rate of microbial transformation of polycyclic aromatic hydrocarbons: a chromatographic quantification procedure.** Herbes, S.E.; Schwall, L.R.; Williams, G.A. (Oak Ridge National Lab., TN). *Appl. Environ. Microbiol.;* **34**: No. 2, 244-246(Aug 1977).

A chromatographic procedure has been developed for isolating and quantifying microbial transformation products of ^{14}C-labeled polycyclic aromatic hydrocarbons. Transformation rates of naphthalene, anthracene, benz(a)anthracene, and benz(a)pyrene by a mixed bacterial population have been measured. With this procedure, extremely slow or incomplete transformations may be quantified that would not be detectable by previously used techniques.

MICROBIOLOGY

REFER ALSO TO CITATION(S) 33757

33849 **Comparison of the economics of acid and enzymatic hydrolysis of newsprint.** Grethlein, H.E. (Univ. of California, Berkeley). *Biotechnol. Bioeng.;* **20**: No. 4, 503-525(Apr 1978).

In order to compare the process economics of making glucose from cellulose, a plant design is presented using acid hydrolysis which can be compared with a published design using enzyme hydrolysis. A common design basis is used; namely, an input capacity of 885 ton/day newsprint with a common technique of cost estimation. The cost of making glucose is in the range of 1.75 to 2.45 cents/lb, depending on the slurry concentration fed to the reactor for the acid hydrolysis. This cost range is less than the published estimate of 5.2 cents/lb for enzymatic hydrolysis.

33850 **Effect of refiner defibrizing on the fermentability of ryegrass straw.** Han, Y.W. (Oregon State Univ., Corvallis); Chen, W.P.; Miles, T.R. *Biotechnol. Bioeng.;* **20**: No. 4, 567-575(Apr 1978).

The effects of two grinding methods, hammer milling and defibrizing by disk refining, on the fermentability of ryegrass straw were investigated. Disk refined or defibrized straw produced more sugar than hammer milled straw. Release of sugar was especially pronounced when H_2SO_4 was added to the straw during the defibrizing process. In vitro rumen digestibility was significantly higher ($P < 0.1$) for defibrized than for hammer milled straw. With semisolid culture the level of yeast growth was about three times as high on the defibrized as on hammer milled straw. A scanning electron micrograph revealed that defibrizing removed the waxy surface of the straw as well as separating fiber bundles, so that the surface area of the exposed fiber structure was increased.

33851 **Power demand and mass transfer capability of mechanically agitated gas-liquid contactors and their relationship to air-lift fermenters.** Legrys, G.A. (Lord Rank Research Center, Bucks, Eng.). *Chem. Eng. Sci.;* **33**: No. 1, 83-86(1978).

Analysis of established correlations for power uptake, gassed power uptake and overall volumetric mass transfer coefficient (k/sub L/α) shows that when operating at constant impeller speed small increases in gas superficial velocity will result in both an increase in k/sub L/α and a decrease in the total power input to the vessel. This is confirmed experimentally. At or near flooding, increasing the superficial velocity will continue to increase k/sub L/α still further, but with no further decrease in the agitator power uptake, total power input will increase. The transition region tends to lie on the corresponding k/sub L/α vs power input relation for an air-sparged situation (i.e. no mechanical agitation). A given mass transfer capability (k/sub L/α) value will be achieved at the same power/unit volume with both air sparged vessels and mechanically agitated vessels providing the gas superficial velocity is greater than 25 mm/sec.

33852 **Comparisons of salt-marsh fucoid production estimated from three different indices.** Brinkhuis, B.H. (State Univ. of New York, Stony Brook). *J. Phycol.;* **13**: No. 4, 328-335(Dec 1977).

Production of Ascophyllum nodosum (L.) LeJolis ecads and Fuscus vesiculosus L. was calculated from measurements of in situ growth, seasonal variations in standing-crops and seasonal variations in photosynthetic capacity. A computer model for predicting daily, monthly and yearly net production from photosynthesis data was constructed. This model used daily irradiation, actual biomass of algae/m^2 contributing to production and photosynthesis vs. light intensity relationships as data inputs. Comparison of production estimated from in situ growth, standing-crops and photosynthesis indicated that both marsh fucoids turn over biomass twice per year. Total net production of both fucoids, estimated from photosynthesis data, was ca. 315 g C . m^{-2} . yr^{-1}. On the other hand, production of both fucoids calculated from standing-crop data was only 155 g c . m^{-2} . yr^{-1}.

33853 **Dependence of reproductive rate on cell size and temperature in freshwater ciliated protozoa.** Finlay, B.J. (Univ. of Stirling, Eng.). *Oecologia (Berlin);* **30**: No. 1, 75-81(1977).

Reproductive rates have been calculated for ten species of ciliated protozoa in defined conditions. Interspecific double log regressions of generation time vs. cell volume have been computed at each of three temperatures (8.5°C, 15°C, and 20°C) indicating a significant dependence of reproductive rate on cell size. Recorded generation times varied from 6.38 h in Vorticella microstoma at 20°C to 1004 h in Spirostomum teres at 8.5°C. These values correspond to a range in r/sub m/ $(day)^{-1}$ of 2.607 to 0.017 and lambda $(day)^{-1}$ of 13.554 to 1.017. The relationship between these data and similar published data for marine ciliates is examined and the value of such regressions in ecological studies of the protozoa is discussed.

MORPHOLOGY

REFER ALSO TO CITATION(S) 33847

PATHOLOGY

REFER ALSO TO CITATION(S) 33982, 33983, 34003

33854 (UCD—472-124, pp 154-156) **Intralesional BCG therapy of canine mammary tumors.** Chrisp, C.E.; Hanna, M.G.; White, R.G.; Shifrine, M.; Wilson, F.D. Oct 1977.

In Annual report, fiscal year 1977.

The morphological response to intra-mammary tumor injection of BCG is being studied cooperatively with the Frederick Cancer Research Center. To date tumors in 14 beagles have been injected and mastectomy done at three time intervals after injection. Histopathology and follow-up of tumor behavior is in progress.

33855 (UCD—472-124, pp 178-181) **Computerization of clinical and pathological diagnosis.** Philbrick, A.L.; Spangler, W.L. Oct 1977.

In Annual report, fiscal year 1977.

A new descriptive code system using the Standard Nomenclature of Veterinary Diseases and Operations (SNVDO) as a core is being developed for the computerization of medical and pathological

data on research beagles at RBL. Trial implementation and analysis of this new tool will give us the perspectives to determine the efficacy of applying such a system to new and past research data. Such a system would permit rapid retrieval of pathology information and facilitate overview comparisons and interpretations.

TRACER TECHNIQUES

33856 **Influence of thiazide on salt hypertension.** Iwai, J.; Ohanian, E.V.; Dahl, L.K. (Brookhaven National Lab., Upton, NY). *Circ. Res.;* **40**: No. 5, I.131-I.134(May 1977).

This study was undertaken to evaluate the effect of chronic diuretic therapy with chlorothiazide on the course of salt hypertension in hypertension-resistant (R) and hypertension-sensitive (S) strains of rats. Investigation of the effects of chlorothiazide on blood pressure, 24-hour urinary ^{24}Na and aldosterone excretion, and plasma renin activity (PRA) produced the following observations: (1) Chlorothiazide failed to prevent the development of salt hypertension in S rats. (2) After 12 weeks, S rats on high salt plus chlorothiazide exhibited a rapid fall in blood pressure to levels indistinguishable from those of S rats on low salt. (3) Chlorothiazide significantly increased urinary ^{24}Na excretion only in S rats on high salt ($P < 0.01$). (4) Chlorothiazide significantly increased PRA and urinary aldosterone excretion in both strains on low or high salt diets ($P < 0.001$). (5) Morbidity and mortality of salt hypertension were alleviated by chlorothiazide treatment. The unique aspect of this study is the finding that chlorothiazide did not abolish the hypertensinogenic action of salt in S rats.

PHYSIOLOGICAL SYSTEMS

REFER ALSO TO CITATION(S) 33771, 33772, 33773, 33774, 33775, 33776, 33777, 33778, 33779, 33780, 33782, 33783, 33784, 33800, 33805, 33810, 33811, 33812, 33813, 33814, 33816, 33817, 33818, 33819, 33820, 33821, 33823, 33824, 33825, 33826, 33827, 33828, 33829, 33830, 33831, 33832, 33833, 33837, 33838, 33840, 33842, 33843, 33844, 33969

33857 (CONF-760927—, pp 1-21) **Increased pulmonary disease mediated through altered bacterial defenses.** Gardner, D.E.; Graham, J.A. (Health Effects Research Lab., Research Triangle Park, NC). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

The process of infection has been defined as an interaction of a host, a microbe, and the environment. In the natural environment, healthy individuals exist in equilibrium with potentially pathogenic microorganisms. Using this concept, an animal-model system was developed to study the effects of pollutants that can affect this equilibrium and result in acute pulmonary disease. Increase of mortality from exposure to several pathogenic organisms has been reported for a variety of animal species after exposure to ozone, nitrogen dioxide, and a variety of trace metals. There are a number of possible mechanisms by which the lung can become more vulnerable to microorganisms. These include reduction in deposition or retention of bacteria, slowing of physical removal of bacterial cells by the mucociliary mechanism, dysfunction of the alveolar macrophages, alteration of the acellular lining material (surfactant) of the deep lung, the presence of edema fluid or inflammatory exudate in the airway, and pulmonary immunosuppression. The influence of environmental pollutants on each of these factors is discussed.

33858 (CONF-760927—, pp 149-161) **Structural organization of mucus in the lung.** Sturgess, J.M. (Hospital for Sick Children, Toronto). 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Mucus is important to pulmonary defense because it acts as a protective barrier that separates epithelial cells from potentially harmful materials and as a vehicle for clearance of particulate and cellular material from the lung. The ultrastructure of mucus has been studied by scanning electron microscopy, and it has been shown that mucus forms a continuous lining over the airway epithelium of the rabbit and human lung. In structural arrangement, mucus forms series of overlapping plaques which vary in appearance from networks of branching and anastomosing fibers to smooth sheets. Newly secreted mucus and mucus adjacent to the epithelium have an open network structure, whereas upper layers of mucus show more tightly bound networks and smoother sheets. The dimensions of the fibrils and the size of the interfibril spaces vary considerably in different regions of the normal lung. A smoother, more continuous layer of mucus with few fine networks is observed in the trachea, whereas more-expanded fibrous networks are observed in the main and lobar bronchi. In chronic obstructive lung disease, the mucus lining is significantly changed, with thicker, more closely bound plaques of condensed mucus, interrupted by channels leading to the pulmonary epithelium. The intricate structural organization of mucus reflects its complex physicochemical properties and its functional ability in clearing particulate material from the lung.

33859 (UCD—472-124, pp 109-110) **Histocompatibility studies in the Davis beagle population: preliminary report.** Stitzel, K.; Vriesendorp, H.; Visser, T.P.; Wilson, F.D. Oct 1977.

In Annual report, fiscal year 1977.

Techniques for histocompatibility typing of dogs by the use of serum defined antigens have been perfected at Davis with the assistance of the Rotterdam-Rijswijk canine tissue typing laboratory. To date over 200 animals within the Davis colony have been defined.

33860 (UCD—472-124, pp 111-113) **Induction of graft-versus-host-disease in immunocompetent dogs with lymphocytes from BCG-immunized donors.** Thilsted, J.P.; Shifrine, M.; Wilson, F.D. Oct 1977.

In Annual report, fiscal year 1977.

GVHD was induced in two dogs, neither of which had received prior immunosuppression, by injection of lymphoid cells from Bacillus Calmette-Guerin-immunized donors. The disease was characterized by weight loss, diarrhea, icterus, thrombocytopenic purpura, leukopenia, and elevated SAP and SGPT. At necropsy the liver and small intestine appeared most severely affected although lesions were found in many organs. The persistence of donor cells was substantiated cytogenetically in the one recipient that received cells from a donor of the opposite sex.

33861 (UCD—472-124, pp 114-115) **Lymphocyte stimulation in the dog: response of lymphocytes from normal and immune dogs to phytohemagglutinin, coccidioidin, and tuberculin.** Thilsted, J.P.; Shifrine, M. Oct 1977.

In Annual report, fiscal year 1977.

The lymphocyte stimulation test has proved a useful test for measuring antigen-specific cell mediated immunity in the dog. The antigen-induced lymphocyte transformation responses correlated well with the immunization histories of the dogs.

33862 (UCD—472-124, pp 117) **Absence of transfer factor in mice.** Thilsted, J.P.; Shifrine, M. Oct 1977.

In Annual report, fiscal year 1977.

Spleen cell donors, either immunized with BCG or unimmunized, were sacrificed, and their spleen cells were extracted for transfer factor (TF) by one of three methods. The TF was injected intraperitoneally into normal recipients, with each animal receiving the TF from 5×10^7 spleen cells. Two days after TF injection the recipients were footpad tested with 0.025 ml of a 0.2% suspension of killed M. tuberculosis. The degree of footpad swelling was determined 48 hr after testing. In two separate experiments, footpad test responses to M. tuberculosis were the same in groups of mice receiving nonspecific TF and in groups of mice receiving tuberculin-specific (Table 1). In the second experiment recipients of nonspecific and tuberculin-specific TF gave footpad responses that were not significantly different from those of saline-injected controls. We thus were unable to duplicate published results showing transfer of sensitivity in mice.

33863 (UCD—472-124, pp 118-119) **Measurement of canine cell mediated immunity with a skin test.** Thilsted, J.P.; Shifrine, M. Oct 1977.

In Annual report, fiscal year 1977.

Coccidioidin and tuberculin-PPD skin tests were completed on 27 different dogs that had been immunized with BCG or coccidioidin or had not been immunized. The BCG-immunized dogs gave high responses to tuberculin-PPD as compared to the nonimmunized and coccidioidinimmunized dogs. The two coccidioidin-immunized dogs gave higher responses to coccidioidin than the nonimmunized and BCG-immunized dogs. These results demonstrate that the skin test response reliably correlates with the immunization histories of the dogs and is antigen specific.

33864 (UCD—472-124, pp 139) **Immunobiology of congenitally athymic-asplenic (LASAT) mice.** Gershwin, M.E.; Ahmed, A.; Shifrine, M.; Wilson, F.D. Oct 1977.

In Annual report, fiscal year 1977.

Congenitally athymic-asplenic (LASAT) mice on an outbred N:NIH(S) background were produced by mating nude mice with hereditarily asplenic (Dh/+) mice. Athymic-asplenic mice survive for up to 9 months, under specific pathogen-free conditions, with no evidence of increased risk of spontaneous neoplasia. Although lymphocyte surface markers and sera immunoglobulin levels of athymic-asplenic mice were similar to those in their nude and asplenic littermates, there were a number of significant differences. Levels of serum IgA in LASAT mice were higher than in nude mice, but lower than in either nu/+ or Dh/+ mice; these differences may have been related to the increased engorgement of Peyer's patches

with histiocytes. Athymic-asplenic mice had normal hematocrit, hemoglobin, and reticulocyte counts but were markedly leukopenic, and had a thrombocytosis and an increased number of bone marrow colony forming units in culture. The response of athymic-asplenic mice to the T cell mitogen, phytohemagglutinin, was reduced markedly. However, numbers of the 1.2 bearing cells, in both Peyer's patches and lymph nodes, while reduced compared to those in either nu/+ or Dh/+ littermates, were significantly higher than in nude mice.

33865 Rat Thy-1 antigens from thymus and brain: their tissue distribution, purification, and chemical composition. Williams, A.F.; Barclay, A.N.; Letarte-Muirhead, M.; Morris, R.J. (Oxford Univ.). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 51-61(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Experiments were conducted to show that the rat Thy-1 antigens are major glycoproteins of the membranes of thymocytes and brain. Results are discussed under the following headings: tissue distribution of the Thy-1 antigen in mouse and rat; amount of Thy-1 antigen in thymus and brain; solubilization of Thy-1 antigen from thymus and brain in detergents; purification of Thy-1 from thymocytes and brain; amino acid and carbohydrate compositions of Thy-1 antigens; chemical basis for the antigenic determinants of Thy-1; Thy-1 antigens as major membrane glycoproteins of thymocytes and brain; and functions for Thy-1. (HLW)

33866 Studies on the interactions between viruses and lymphocytes. Bloom, B.R.; Senik, A.; Stoner, G.; Ju, G.; Nowakowski, M.; Kano, S.; Jimenez, L. (Albert Einstein Coll. of Medicine, Bronx, NY). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 73-83(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: virus plaque assay; kinetics of activation of virus plaque-forming cells; the nature of the virus plaque-forming cell; the nature of the T cell measured by the virus plaque assay; and replication of vesicular stomatitis virus by lymphocytes. It is suggested that studies of virus-lymphocyte interactions have the potential to provide a means for quantitating specifically activated T cells, a method for selective immunosuppression, and some insight into the mechanisms of latent or persistent viral infections. (HLW)

33867 Tolerance: two pathways of negative immunoregulation in contact sensitivity to DNFB. Claman, H.N.; Miller, S.D.; Moorhead, J.W. (Univ. of Colorado, Denver). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 105-111(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The model of tolerance was adapted to contact sensitization to 1-fluoro-2, 4-dinitrobenzene (DNFB) in the mouse. The efficiency of tolerization was also a function of the chemical reactivity of the tolerogen. Highly reactive DNFB was a potent tolerogen, weakly reactive $DNBSO_3$ was a mild tolerogen, and nonreactive DNP-lysine was not tolerogenic. In vitro studies of contact sensitivity gave similar results with regard to the stimulation of lymphoid cells from sensitized mice. A table is presented to show that the ability of compounds to couple to proteins is directly related to their ability to sensitize epicntaneously, tolerize parenterally, and stimulate lymphoid cells from DNFB-sensitized mice. Discussions are presented of membrane-associated DNFB, transfer of tolerance, kinetics of tolerance induction and transfer, and specificity of tolerance. (HLW)

33868 Current concepts of the antibody response: heterogeneity of lymphoid cells, interactions, and factors. Feldmann, M. (University Coll., London); Beverley, P.; Erb, P.; Howie, S.; Kontiainen, S.; Maoz, A.; Mathies, M.; McKenzie, I.; Woody, J. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 113-118(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Evidence is described for T-T interactions, for the existence of subsets of T cells with defined functions, for subcellular factors as mediators of these interactions, and for the heterogeneity of lymphocyte receptors for antigen. The following topics are discussed: cell interactions in the induction of helper cells; interactions in the induction of suppressor T cells; heterogeneity of T cells; cell cooperation in immune induction; and speculations on T-cell receptors. (HLW)

33869 Functional and structural characterization of immunoglobulin on murine B lymphoctes. Parkhouse, R.M.E.; Abney, E.R.; Bourgois, A.; Willcox, H.N.A. (National Inst. for Medical Research, London). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 193-200(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Evidence for a structural homology between human IgD and its presumed mouse counterpart has been provided by the remarkably similar profiles of fragments resulting from tryptic digestion of the human and mouse proteins. More definitive homology awaits sequence determination. The memory cells of two antibody-forming cell clones had receptors of the IgM class, even though the clones had been producing IgG1 or IgG2a anti-DNP antibodies for 9 to 15 months previously (on antigenic stimulation). Thus a phenotypic switch in heavy-chain constant region evidently occurred after reexposure of these memory cells to antigen. These conclusions were drawn because removal of IgM, but not IgG or IgD, from the memory-cell population inhibited antigen recognition and subsequent differentiation to IgG-secreting cells. Thus surface IgM cannot be solely responsible for tolerance induction; neither can IgD be the unique triggering receptor for antigen on memory B cells. Instead, there may be a heterogeneity of Ig receptors on memory (and other) B lymphocytes which reflects the presence of subpopulations arising in the presence and absence of antigenic selection. Preliminary evidence does suggest that the immediate precursors of IgG-bearing cells may express either IgM or IgD. Thus IgG expression can occur independently of IgD, which would be in accord with our finding that at least some memory B cells recognize antigen via surface IgM. The details of the control and evolution of Ig expression remain to be elucidated, as does a defined role for IgD. The cells which bear IgD, however, are certainly derived from IgM-positive precursor lymphocytes, and the high frequency of lymphocytes expressing two Ig classes has profound implications for the mechanism of V-C gene integration.

33870 Origin and differentiation of lymphocytes involved in the secretory IgA response. Cebra, J.J.; Gearhart, P.J.; Kamat, R.; Robertson, S.M.; Tseng, J. (Johns Hopkins Univ., Baltimore). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 201-215(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Experiments are described for the following studies on the role of Peyer's patches in immunity: antigen-sensitive B lymphocytes in Peyer's patches and generation of IgA antibody response by these lymphocytes; frequency of antigen-sensitive cells in Peyer's patches and other lymphoid tissues and assessment of their potential to express various Ig isotypes; repopulation of histocompatible intestinal lamina propria with IgA plasma cells following Peyer's patch cell transfer from congenic donors; and a model system for the induction of humoral immunity in the gut. (HLW)

33871 Lymphocyte surface immunoglobulins: evolutionary origin and involvement in activation. Marchalonis, J.J.; Decker, J.M.; DeLuca, D.; Moseley, J.M.; Smith, P.; Warr, G.W. (Royal Melbourne Hospital). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 261-273(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

The following topics are discussed: evolutionary emergence of T and B cells; surface immunoglobulins of thymus and spleen lymphocytes of the goldfish; detection by fluorescent antibody analysis; isolation and partial characterization of immunoglobulins; immunoglobulins of T lymphoma cells; surface immunoglobulins of B cells; surface immunoglobulin and lymphocyte activation; and an antigen-recognition cell-activation complex. (HLW)

33872 Immune response to staphylococcal nuclase: a probe of cellular and humoral antigen-specific receptors. Sachs, D.H.; Berzofsky, J.A.; Fathman, C.G.; Pisetsky, D.S.; Schechter, A.N.; Schwartz, R.H. (National Institutes of Health, Bethesda, MD). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 295-306(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

We have directed a variety of immunologic studies toward staphylococcal nuclease as a model antigen. Although nuclease is a naturally occurring protein antigen with a complex amino acid composition and globular structure, a pattern of Ir gene control of the humoral response to nuclease comparable to that obtained for simpler copolymers has been observed. The in vitro T-cell proliferative response to nuclease has been found to follow a similar pattern of genetic control. In addition, the availability of well-characterized polypeptide fragments from nuclease provides a tool for dissecting the molecule's antigenicity. Finally, at least a portion of the antibodies produced against nuclease appear to bear idiotypic determinants detectable in a simple assay involving inhibition of antibody-mediated inactivation of the enzymatic activity of nuclease, providing a convenient marker for the antibody receptor site of mouse antinuclease antibodies. In this paper, we will attempt to summarize the present state of our investigations of the immune response to nuclease in mice and will discuss some correlations and contradictions among these studies in terms of their possible implications for the mechanism of Ir gene control.

33873 Structural and functional heterogeneity of Fc receptors. Grey, H.M.; Anderson, C.L.; Heusser, C.H.; Borthistle, B.K.; Von Eschen, K.B.; Chiller, J.M. (National Jewish Hospital and Research Center, Denver). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 315-321(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

It has been possible to show at three levels of investigation that there is heterogeneity of FcR on different lymphoid cells. First, heterogeneity at the biologic level is suggested in two situations in which immunoglobulins of different subclasses have quite different biologic effects on lymphocytes and their immunologic potential. Although the actual mechanism behind these subclass-specific differences is at present unclear, it would appear reasonable to suggest that discrete FcR may be involved in these functions. Second, binding studies have confirmed that at least some heterogeneity exists between different cell types with respect to their capacity to bind different IgG subclasses. This is most evident when monomer and aggregated immunoglobulins are compared. At the present time, however, it is not possible to establish a clear relationship between this heterogeneity and the heterogeneity that exists at the biologic level.

33874 Structural studies of β_2-microglobulin-associated and other MHC antigens. Peterson, P.A.; Anundi, H.; Curman, B.; Klareskog, L.; Kvist, S.; Oestberg, L.; Rask, L.; Sandberg, L.; Sege, K. (Uppsala Univ.). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 331-339(1977).

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The major histocompatibility complex (MHC) is known to control several immunobiological phenomena, particularly in the cellular system. Although the structural genes for heavy and light immunoglobulin (Ig) chains are located on chromosomes separate from that carrying the MHC, an iteresting link between the humoral and cellular systems is provided by β_2-microglobulin. Its appearance as a "free immunoglobulin domain" and its association with several gene products of the MHC region may indicate that some of the key molecules in the cellular immune system share not only functional but also structural features with antibodies. The association of β_2-microglobulin with at least three gene products of the mouse MHC strongly supports the idea that several loci in the MHC have arisen by gene duplication events. To examine which loci control the expression of structurally similar molecules, we have attempted to isolate and characterize several of the known gene products of the MHC. This paper summarizes some of our recent information.

33875 Structural studies of H-2 and TL alloantigens. Uhr, J.W. (Univ. of Texas, Dallas); Vitetta, E.S.; Klein, J.; Poulik, M.D.; Klapper, D.G.; Capra, J.D. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 363-368(1977).

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Questions concerning the association of β-2-microglobulin (β_2m) with H-2 and TL antigens on the cell surface or the existence of β_2m in the free form and associated with many other molecules were investigated. If there is a large excess of free β_2m it could be argued that the association with H-2 is fortuitous and occurs during the isolation procedure or during capping. Studies were also conducted on the partial primary structure of two H-2K haplotypes in relation to their being alleles and homology between H-2K and immunoglobulin domains. (HLW)

33876 Chemical and immunological characterization of HL-A-linked B-lymphocyte alloantigens. Springer, T.A. (Harvard Univ., Cambridge, MA); Kaufman, J.F.; Siddoway, L.A.; Giphart, M.; Mann, D.L.; Terhorst, C.; Strominger, J.L. *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 387-396(1977).

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The purification of papain-solubilized HL-A-linked B-cell alloantigens has been reported recently. They contain polypeptides of 23,000 (p23) and 30,000 (p30) m.w. The papain-solubilized products have been characterized immunologically but not chemically. Antisera to these products are potent inhibitors of the MLC reaction and precipitate from detergent-solubilized extracts polypeptides of 27,000 and 35,000 m.w. This paper describes the isolation of HL-A-linked B-cell alloantigens in intact form, their subunit structure and immunologic properties, and the chemistry of their subunits. The implications of the homologous subunit structure of these antigens and their similarities to murine and guinea pig immune-associated (Ia) antigens are discussed.

33877 Guinea pig MHC: functional significance and structural characterization. Schwartz, B.D.; Kask, A.M.; Shevach, E.M. (National Inst. of Allergy and Infectious Diseases, Bethesda, MD). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 397-406(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Over the past several years, we have utilized a combination of serologic, chemical, and functional studies in both inbred and outbred animals which have allowed us to identify genes within the GPLA complex that encode histocompatibility antigens, Ia antigens, and immune response function. This paper reports a summary of those studies. Our results indicate that the GPLA complex is homologous to the murine H-2 and human HL-A complexes, and that the guinea pig I region contains at least three subregions, each of which encodes an Ia antigen with a characteristic molecular structure.

33878 Analysis of lymphocyte surface antigen expression by the use of variant cell lines. Hyman, R.; Trowbridge, I. (Salk Inst. for Biological Studies, San Diego). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 407-415(1977).

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The cell surface is believed to be the site of many important functions, including cell recognition and the regulation of cell growth. It is also probable that tissue-specific surface molecules play a role in the differentiated functions of that tissue. That these concepts can still only be considered in the most general terms reflects the present lack of detailed knowledge about the organization of the plasma membrane, the structure of its individual components, and their biosynthesis. The type of approach described here to attack these problems, which uses both genetic and structural analysis, offers some promise of contributing to their future solution.

33879 Cold Spring Harbor symposia on quantitative biology. Volume 41. Part 2. Origins of lymphocyte diversity. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977). 508p. (CONF-7606152—P2). 2-part set.

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

Separate abstracts were prepared for the 49 papers presented at the conference. (HLW)

33880 Cellular recognition of major histocompatibility complex antigens. Bach, F.H.; Bach, M.L.; Kuperman, O.J.; Sollinger, H.W.; Sondel, P.M. (Univ. of Wisconsin, Madison). pp 429-441 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

We have recently reviewed in detail the genetic and cellular dichotomy observed in the generation of cytotoxic lymphocytes in the CML assay. In summary, the effective generation of cytotoxic T lymphocytes, at least in some cases, requires two functionally distinct subclasses of T lymphocytes and the recognition of two genetically and functionally distinct types of MHC antigens, LD and CD. These findings have allowed the formation of the following cellular model. Specific recognition of LD antigens stimulates both proliferation and helper activity by a population of "proliferative helper T cells;" these cells can then provide a collaborative interaction (signal 2) to antigen-specific cytotoxic T-lymphocyte precursors that have already recognized the foreign CD antigen (signal 1). In this paper, we first review the relatively recent methods for specifically identifying LD antigens controlled by the MHC; then we further elaborate upon the above model and extend it to more recently examined systems of LD and CD interactions, namely, suppression, tolerance, and in vivo graft rejection.

33881 Histocompatibility-2 system of wild mice. IV. Ia and Ir typing of two wild mouse populations. Klein, J. (Univ. of Texas, Dallas); Merryman, C.F.; Maurer, P.H.; Hauptfeld, M.; Gardner, M.B. pp 457-463 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Low responders to GAT^{10}, GLT^{15}, or $GLphi^{5}$ polymers were found in two wild mouse populations tested. The frequency among wild mice of low responders to these antigens was found to be approximately the same as that among inbred strains. The relatively high frequency of low responders among wild mice could be interpreted as suggesting that low responsiveness, under certain circumstances, might be selectively advantageous. Among wild mice, low responsiveness to GAT^{10} and $GLphi^{5}$ is probably associated with H-2 haplotypes different from those among inbred strains. Certain Ia antigens occur among wild mice and inbred strains with relatively high frequency (public Ia antigens), whereas others occur with low frequency (private Ia antigens). Wild mice probably carry Ia antigens that do not occur among inbred strains. The polymorphism of Ia loci is probably high.

33882 Serological and functional evidence for further subdivision of the I regions of the H-2 gene complex. Shereffler, D.C. (Washington Univ., St. Louis); David, C.S.; Cullen, S.E.; Frelinger, J.A.; Niederhuber, J.E. pp 477-487 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Evidence is presented from four different approaches that suggests the existence of two new subdivisions between I-B and I-C, one (I-J) identical to that defined by Tada and Murphy, which determines an Ia antigen(s) on T lymphocytes, and the other (I-E) defined by reactivity with B lymphocytes and a subpopulation of T lymphocytes.

33883 Functional and genetic analysis of Ia antigens. McDevitt, H.O.; Delovitch, T.L.; Press, J.L. (Stanford Univ., CA). pp 489-496 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Using negative selection with anti-Ia serum and complement, Ia-"negative" lymphocyte populations give rise to clonal progeny which produce only IgM antibody, whereas Ia-positive lymphocytes generate B-cell progeny which produce IgG or both IgM and IgG antibody. The responder cell in the mixed lymphocyte reaction and the precursor and effector cells in cell-mediated lympholysis appear to be Ia-"negative" lymphocyte subpopulations. Helper T cells in some systems are Ia-positive, and allotype suppressor T cells are also Ia-positive. Allogenic effect factor produced in the usual manner functions as an antigen nonspecific helper factor for several different H-2 haplotypes. However, when allogenic effect factor is produced from a mixed lymphocyte culture between responder lymphocytes treated with anti-Ia and complement and irradiated stimulator lymphocytes treated with anti-Thy-1.2 and complement, this "restricted" AEF is sharply restricted in the haplotypes it can stimulate. "Restricted" AEF produced in this manner with B10.BR responder cells and B10.S stimulator cells helps B10.S T-cell-depleted, hapten-primed spleen B cells but does not help B10.BR spleen cells. This raises the possibility that the Ia antigens in AEF may be derived from the stimulator B cells and/or macrophages rather than from the responder T cells.

33884 Selective expression of separate I-region loci in functionally different lmphocyte subpopulations. Murphy, D.B.; Okumura, K.; Herzenberg, L.A.; Herzenberg, L.A.; McDevitt, H.O. (Stanford Univ., CA). pp 497-504 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

Determinants controlled by separate loci mapping in the I region of the H-2 gene complex are selectively expressed on subpopulations of lymphocytes which play different roles in generating humoral responses. The Ia-4 locus, which marks a new I subregion, designated I-J, controls determinants found on allotype suppressor and normal (nonsuppressed) T lymphocytes. These determinants are not present on helper T lymphocytes or B lymphocytes. In contrast, the Ia-1 locus, which marks the I-A subregion, controls determinants present on B lymphocytes but not on suppressor or helper T lymphocytes. Another locus (subregion not known) controls determinants which distinguish helper T lymphocytes from suppressor T lymphocytes. Such selective expression suggests that the products of these loci may play an integral role in lymphocyte interactions.

33885 F_1 hybrid antiparental cell-mediated lympholysis: a comparison with bone marrow graft rejection and with cell-mediated lympholysis to alloantigens. Shearer, G.M. (National Cancer Inst., Bethesda, MD); Cudkowicz, G.; Schmitt-Verhulst, A.M.; Rehn, T.G.; Waksal, H.; Evans, P.D. pp 511-518 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

The experiments reviewed here demonstrate that CML reactions can be generated in mouse strain combinations for which in vitro reactions to classical H-2K and H-2D alloantigens and in vivo skin graft rejections are precluded. Nevertheless, such combinations are characterized by strong reactivity in vivo against Hh-1 incompatible hemopoietic grafts. Four positive correlations have been demonstrated thus far between hemopoietic graft rejection in vivo and F_1 antiparent cell-mediated cytotoxicity in vitro. These include genetic polymorphism, immunologic maturation, antigen-induced specific unresponsiveness, and selective but nonspecific abrogation of responsiveness either by antisera or antimacrophage agents. The observations that F_1 antiparent cytotoxic potential develops later than immunity to alloantigens and that selective abolition of F_1 antiparent cytotoxicity can be achieved without abrogation of reactivity to alloantigens suggest that these two cell-mediated immune phenomena may be generated by different mechanisms, and common mechanisms may exist between the rejection of parental bone marrow grafts by irradiated F_1 mice in vivo and the generation of F_1 antiparent cytotoxicity.

33886 Cytotoxic T-cell response to histocompatibility antigens: the role of H-2. Bevan, M.J. (Salk Inst. for Biological Studies, San Diego, CA). pp 519-527 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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A requirement for susceptibility to lysis by CTL immunized against minor-H differences is that the targets carry the same combination of minor-H and H-2 alleles as was used to immunize. Two hypotheses have been proposed to explain H-2 restriction of the interactions of T cells with other cells: the intimacy or dual-recognition hypothesis states that T cells have two types of receptors on their surfaces, one being an H-2-coded, cellular-interaction (CI) structure which binds complementary self H-2 products, and the other, a T-cell receptor which binds the foreign antigen. The altered-self hypothesis predicts that there is one receptor on T cells which only recognizes antigens in association with H-2, that is, interaction antigens or new antigenic determinants. I have summarized the work on the CTL response to immunization with major- and minor-H alloantigens which is relevant in deciding between the one-receptor and two-receptor hypotheses. I favor the one-receptor explanation mainly for the following reasons: it more easily accommodates anti-H-2 and anti-minor-H killing in one mechanism, it offers an attractive explanation of the phenomenon of alloaggression, and H-2 polymorphism is given a very important function in the species immune-defense mechanisms.

33887 Recognition of alterations induced by early vaccinia surface antigens and dependence of virus-specific lysis on H-2 antigen concentration on target cells. Koszinowski, U. (Univ., Goettingen, Ger.); Ertl, H.; Wekerle, H.; Thomssen, R. pp 529-537 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

Specific recognition of antigens by cytolytic T lymphocytes sensitized to vaccinia virus was tested by monolayer adsorption. Adsorption was possible only on monolayers also expressing syngenic H-2 as viral antigens present during the sensitization phase. Vaccinia-virus-infected target cells were subjected to papain and neuraminidase treatment. H-2 antigenic determinants could be removed by papain treatment. Due to virus-specific inhibition of host-cell protein synthesis, reexpression of H-2 antigenic determinants did not take place, but viral surface antigens were resynthesized. Susceptibility of target cells to T-cell-mediated lysis was decreased after papain treatment. Substrains of vaccinia virus were used in order to define the minimal changes induced by vaccinia virus necessary for T-cell sensitization in vivo and target-cell lysis in vitro. When the immune response to a conditional lethal mutant strain of vaccinia virus was investigated, it could be demonstrated that expression of early surface antigens is sufficient for induction of the cellular immune reactions. These data were confirmed by inhibition studies with virus-specific antisera.

33888 Influence of H-2 gene products on cell-mediated and humoral immune responses. von Boehmer, H. (Basel Inst. for Immunology); Sprent, J.; Haas, W. pp 539-545 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

Recently, we have obtained tolerant T cells from chimeric mice, i.e., lethally irradiated F_1 hybrid mice injected with stem-cell populations of either one or both parental strains. We have now analyzed the capacity of T cells from such mice to respond to non-H-2 antigens expressed or processed by allogenic cells, i.e., cells expressing the H-2 determinants to which the T cells are tolerized. With respect to T-B collaboration, we have also used an alternative system for depleting T cells of alloantigen-reactive lymphocytes. This system—originally described by Ford and Atkins—involves "filtering" T cells from blood to lymph through irradiated F_1 hybrid mice to remove cells reactive to the H-2 antigens of the host. As described in this report, we, like others, have come to the conclusion that the specificity of T cells stimulated with non-H-2 antigens is strongly influenced by the H-2 determinants to which the antigens become associated, and that this influence is not restricted to self H-2 determinants.

33889 Recognition of H-2 and viral antigens by cytotoxic T cells. Schrader, J.W.; Henning, R.; Milner, R.J.; Edelman, G.M. (Rockefeller Univ., New York). pp 547-557 of Cold Spring Harbor sympo-

sia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

The first set of experiments showed that cytotoxic cells generated against H-2-compatible tumor cells were not absolutely restricted from lysing H-2-incompatible target cells, suggesting that selection of T cells with differing specificities for recognition of syngenic H-2 antigens could occur and indicating that the receptors for syngenic H-2 antigens may be heterogeneous. The second group of experiments examined whether viral and H-2 determinants occur in close association on the cell surface. It was found that capping or patching of H-2 antigens on EL-4 tumor cells resulted in a redistribution of the staining seen with a rabbit anti-Rauscher leukemia virus serum. Another series of experiments used the lysostrip technique. Pretreatment of EL-4 cells with rabbit anti-Rauscher leukemia virus serum and goat anti-rabbit Ig serum resulted in a decrease in the susceptibility of the EL-4 cells to lysis by subsequent treatment with anti-H-2 serum and complement. The results of these two types of experiments suggest that viral and H-2 determinants can exist in close association on the cell surface. A third group of experiments showed that specific T cells lysed target cells that had been coated with uv-inactivated Sendai virus and that this lysis was restricted by the H-2 haplotype of the target cell.

33890 Possibility of multiple T-cell receptors. Wilson, D.B. (Univ. of Pennsylvania, Philadelphia); Heber-Katz, E.; Sprent, J.; Howard, J.C. pp 559-561 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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A variety of experiments suggested the possibility of multiple receptor repertoires in the recognition apparatus of T cells for antigen. These include: the high frequency of alloantigen reactive cells, both of the Ly-1 subset responsible for MLI, GVH reactions, helper function, and DTH, and of the Ly-2,3 subset responsible for direct CTL activity and which contains the CTL precursors; the requirement for MHC I-or K,D-region compatibility for the induction and expression of T-cell-mediated immune responses to specific antigens; and the quantitatively normal helper effects for a presumably unrelated antigen exhibited in a population of T cells selectively enriched on the basis of its reactivity to a known MHC alloantigen(s).

33891 Rabbit immunoglobulin allotypes: complexities of their genetics, expression, structural basis, and evolution. Mage, R.G. (National Institutes of Health, Bethesda, MD); Young-Cooper, G.O.; Rejnek, J.; Ansari, A.A.; Alexander, C.B.; Appella, E.; Carta-Sorcini, M.; Landucci-Tosi, S.; Tosi, R.M. pp 677-686 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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In view of the possibility that some allotypic determinants may function as cell-surface recognition structures through which regulatory cells and factors may control cell functions, we have reemphasized the well-known fact that rabbits may express elevated levels of unusual gene products after hyperimmunization. It is likely that information for gene products rarely expressed may be "hidden" in the genomes of many rabbits. However, it is probably an oversimplification to conclude from presently available data that all rabbits have the same genomic content of structural genes for complex allotypes and that all of their polymorphism is at the level of regulatory genes. The long evolutionary history of homologs of rabbit kappa-chain allotypes and the structural and serological complexities of rabbit V/sub H/ allotypes suggest that some intermediate situation may be closer to the truth. That is, some rabbits may have some "latent" genes and others may not. Finally, Ig genetics has provided valuable models of the complexities of multigenic chromosomal regions with potential relevance to other systems such as the genes in the major histocompatibility complex (MHC). Characterization of Ig allotypic determinants at the structural level can also provide more general models for complex allotypes such as those that may be coded for by genes in the MHC.

33892 Uniformity in a clonal repertoire: a case for a germ-line basis of antibody diversity. Claflin, J.L. (Univ. of Michigan, Ann Arbor); Rudikoff, S. pp 725-734 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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One aspect of research on the genetic control of idiotypes has been to study antibody diversity using the immune response to phosphorylcholine (PC) in mice as a model system. Our efforts have been concentrated on this model for two main reasons: the response is clearly predominated by a few clones, and five PC-binding myeloma proteins have been described which could serve as prototypes for anti-PC antibody secreted by five separate clones. The response to PC and the interpretation of it thus appeared to be more complex than originally thought, and this prompted us to reexamine the response with a more critical approach. Experiments described in this paper attempt to resolve some of the issues. Based on an examination of the response in 18 different inbred strains of mice, we find that clones selected during the immune response to PC comprise a limited set in each strain, and the immune response to PC is conserved; a similar (or equivalent) set of clones exists in each strain of mice. The data are surprising and place added constraints on those theories of the generation of diversity that rely on mutational mechanisms.

33893 Inheritance of antibody specificity. IV. Control of related molecular species by one V/sub H/ gene. Maekelae, O.; Karjalainen, K. (Helsinki Univ.). pp 735-741 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Products of two unrelated V/sub H/ genes or gene clusters of the mouse, V/sub H/ABA-HOP/sup b/ and V/sub H/NP/sup b/, were studied by submitting antisera of immunized mice (either ABA-HOP-immunized or NP-immunized) to an IEF analysis and fine-specificity tests (affinities for a series of structural analogs). Products of both genes had an exotic (heteroclitic) fine-specificity. The products of both genes included several molecular species detectable by IEF (spectrotypes). Some of them were shared by many immunized mice (shared spectrotypes), but others occurred only in one mouse of several tested. Fine-specificity of two shared spectrotypes of the V/sub H/NP/sup b/ gene, N-1 and N-4, were determined. Both were heteroclitic but they differed in nuances of the fine-specificity. Occurrence of different spectrotypes in the course of an NP immunization had a regular pattern. In the primary response, we could detect at least four shared spectrotypes (N-1, N-2, N-3, and N-4). They were predominant in the early response (days 8—14) but less so on day 30. In the secondary response, shared spectrotypes were in the minority, and, in the tertiary response, they had been fully replaced by individual spectrotypes which had a higher affinity for NP than the shared spectrotypes.

33894 Genetic dissection of a specific humoral immune response to α(1,3) dextran. Geckeler, W.; Blomberg, B.; de Preval, C.; Cohn, M. (Salk Inst. for Biological Studies, San Diego, CA). pp 743-748 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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The immune response to α(1,3) dextran is the only one known where genetic dissection of the response can be used to reveal possible somatic mechanisms. The rapid response of a prototype BALB/c mouse to α(1,3) dextran is pauciclonal in the lambda 1 : Id^+ class, which we postulate to be germline-encoded. Mutants affecting the expression of either V/sub lambda 1/ or the corresponding V/sub H lambda 1// sup α(1,3)/ delete the response to α(1,3) dextran in the lambda$_1$: Id^+ class. For such impaired mice to respond to α(1,3) dextran, they must utilize V/sub K/ or V/sub H/ genes which have not been selected specifically for this activity in the germ line. Their response is therefore slow since, as we postulate, it depends upon the appearance of somatic variants in V/sub K/ and V/sub H/ gene pairs.

33895 Regulation of immunoglobulin expression in mouse myeloma cells. Margulies, D.H.; Cieplinski, W.; Dharmgrongartama, B.; Gefter, M.L.; Morrison, S.L.; Kelly, T.; Scharff, M.D. (Albert Einstein Coll., Bronx, NY). pp 781-791 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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We will review the genetic information we have obtained by isolating somatic cell hybrids of mouse myeloma cells expressing different classes and subclasses of immunoglobulin, and isolating and characterizing cells that have undergone stable variations or mutations in immunoglobulin production.

33896 Somatic cell genetics of antibody-secreting cells: studies of clonal diversification and analysis by cell fusion. Milstein, C.; Adetugbo, K.; Cowan, N.J.; Koehler, G.; Secher, D.S.; Wilde, C.D. (MRC Lab. of Molecular Biology, Cambridge, Eng.). pp 793-803 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

Four spontaneous structural mutants of the mouse myeloma MOPC-21 have been elucidated by amino acid sequence analysis, cell-free synthesis experiments, and studies of the isolated mRNA. The mutants are due to defects in the heavy-chain cistron. IF1 and IF3 involve deletions of the C/sub H/3 domain due to early termination and to a frameshift, respectively. IF2 is an internal deletion resembling the heavy-chain disease of humans, and IF4 is an amino acid substitution due to point mutation. Their relevance to antibody diversity was discussed. Other clonal variants which do not secrete immunoglobulin have also been studied. Two of them contain an inactive mRNA. The nature of these defects has been studied by complementation analysis by cell fusion. Cell fusion has also been used to develop new cell lines capable of antibody synthesis. The procedure is based on fusion of myeloma cells and spleen cells from normal mice immunized with sheep red blood cells and TNP-carrier antigens. Five such hybrids were described. Methods for the specific detection of cloned variants, based on the cross-reactivity of the cell lines, were describee. These cloned lines can be grown in mice as tumors, and specific antibody has been isolated from their serum. The N-terminal sequence of the L and H chains of one of these antibodies was described. Experiments designed to detect spontaneous recombination or in vitro switch from μ to γ have been negative.

33897 I/sub B/-peptide marker and the Ly-3 surface alloantigen: structural studies of a V/sub k/-region polymorphism and a T-cell marker determined by linked genes. Gottlieb, P.D.; Durda, P.J. (Massachusetts Inst. of Tech., Cambridge). pp 805-815 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

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See CONF-7606152—P2.

We describe a genetic marker in the V region of mouse Ig L chains called the I/sub B/-peptide marker. The genetic locus governing expression of this V/sub L/-region genetic marker has been shown to be closely linked to the Ly-2 and Ly-3 loci which determine expression of T-lymphocyte surface antigens. If the locus governing expression of the I/sub B/-peptide marker contains structural genes coding for V/sub L/ regions, this would be the first placement of Ig genes of any kind in a linkage map. However, the locus governing expression of this V/sub L/-region genetic marker may be regulatory in nature, and it may govern expression of V/sub L/ genes encoded elsewhere in the genome. After a description of the I/sub B/-peptide marker and its genetic linkage with the Ly-2 and Ly-3 loci, we discuss several hypotheses which might account for the linkage of a serum Ig genetic marker with loci determining thymocyte surface antigens. Also included is a brief description of structural studies of the Ly-3 alloantigens which were undertaken in part to determine whether Ig L chains may be associated with or structurally homologous to the Ly-3 antigens.

33898 Structure and genetics of mouse immunoglobulins: an analysis of NZB myeloma proteins and sets of BALB/c myeloma proteins binding particular haptens. Hood, L.; Loh, E.; Hubert, J. (California Inst. of Tech., Pasadena). pp 817-836 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The mouse myeloma data presented in this paper add to our understanding of the organizational features and diversity patterns of the antibody gene families: The NZB and BALB/c myeloma proteins differ in their structural and functional properties. The most likely explanation is that different subsets of lymphocytes are transformed by the myeloma process in these two strains. The examination, through the first hypervariable region, of sets of myeloma proteins binding various haptens demonstrates that the corresponding V/sub L/ and V/sub H/ regions generally fall into subgroups characteristic for each specificity. Thus new subgroups (V genes) are defined for the variable regions of myeloma proteins binding most haptens examined. Indeed, the V/sub H/III subgroup of the mouse has now been divided into at least three separate subgroups by this analysis. The closely related sets of completely sequenced V regions suggest that certain V regions are encoded directly by germline genes. These observations also place constraints on the putative somatic mutational mechanism. The nucleic acid hybridization studies on the mouse lambda family suggest that somatic mutation may generate the lambda variants. Various studies also suggest that bona fide antibodies can be directly encoded by germ-line genes. Thus both of these genetic mechanisms, multiple germ-line genes and somatic mutation, may contribute to antibody diversity. Combinatorial association and multispecificity have not been effectively assessed.

33899 Genetic control of antibody variable regions. Weigert, M.; Riblet, R. (Inst. for Cancer Research, Philadelphia). pp 837-846 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Studies on the myeloma proteins of the inbred mouse have shown that the variability for a germ-line gene is generated somatically. The pattern of variability is simple when examined in the absence of genetic polymorphism and, as in the case of mouse V/sub lambda/, when focused on the products of one germ-line gene (i.e., subgroup). From the overlap sequences, the product of a germ-line gene, V/sub lambda 0/ can be identified. The locations of the amino acid substitutions in V/sub lambda variants suggest that these variants are sequentially selected by antigen. That a V/sub lambda/-like pattern is common to all germ-line gene products is suggested from limited comparisons within two different V/sub K/ subgroups.

33900 Origin of immunoglobulin gene diversity: the evidence and a restriction-modification model. Leder, P.; Honjo, T.; Seidman, J.; Swan, D. (National Institutes of Health, Bethesda, MD). pp 855-862 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

We present the results of experiments which require us to consider quite seriously a somatic mutation mechanism as being involved in the final stages of the generation of immunoglobulin (Ig) diversity. We also present a plausible—but, more important, experimentally testable—model by which the unusual events required by the somatic mutation hypothesis could be accomplished.

33901 Significance of hybridization kinetic experiments for theories of antibody diversity. Smith, G.P. (Univ. of Missouri, Columbia). pp 863-875 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The results of several hybridization kinetic experiments with mouse lambda probes (as well as with various kappa-chain probes) are consistent with a small number of complementary genes per haploid genome. These experiments are often interpreted (though seldom by the investigators themselves) as strong evidence against the germ-line theory. I will argue in this paper that when these data are analyzed more critically than hitherto, they are revealed to constitute only rather weak evidence against the germ-line theory.

33902 Somatic changes in the content and context of immunoglobulin genes. Tonegawa, S.; Hozumi, N.; Matthyssens, G.; Schuller, R. (Basel Inst. of Immunology). pp 877-889 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

The following topics are discussed: joining of kappa-chain genes during ontogeny; arrangements of lambda-chain genes; models for v-c joining at DNA level; implications of somatic joining; new evidence for somatic generation of antibody diversity; hybridization kinetics of individual DNA components; and the existence of multiple V genes. (HLW)

33903 Summary: understanding selective molecular recognition. Edelman, G.M. (Rockefeller Univ., New York). pp 891-902 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Some topics discussed are as follows: requirements of clonal selection; antibody molecules; genes and gene counting; ontogeny and the zero/sup th/ stage of clonal selection; cell interactions and the new physiology of the immune response; the T-cell receptor; histocompatibility loci; triggering, maturation, and mitogenesis; and the generalization of immunology. (HLW)

33904 Ontogenesis of lymphocyte diversity in anuran amphibians. Du Pasquier, L.; Wabl, M.R. (Basel Inst. for Immunology). pp 771-779 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

In this paper, the differentiation of the anuran immune system is followed during ontogeny with special emphasis on the following two aspects of lymphocyte diversity: the genesis of T-B heterogeneity, and the acquisition of antibody diversity.

33905 Genetic restriction of macrophage-lymphocyte interactions in secondary antibody responses in vitro. Pierce, C.W.; Kapp, J.A.; Benacerraf, B. (Harvard Medical School, Boston). pp 563-570 of Cold Spring Harbor symposia on quantitative biology. Vol. 41. Part 2. Cold Spring Harbor, NY; Cold Spring Harbor Laboratory (1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

See CONF-7606152—P2.

Experiments were conducted to compare the ability of syngeneic and allogeneic macrophages to support the development of primary and secondary antibody responses in vitro. Results are discussed with regard to the following: ability of snygeneic and allogeneic macrophages to support development of primary antibody responses in vitro; ability of syngeneic and allogeneic macrophages to support development of secondary antibody responses in vitro; localization of genetic restrictions regulating macrophage-lymphoid cell interactions in secondary PFC responses to the H-2 complex; and ability of syngeneic and allogeneic macrophages to stimulate antibody responses to GAT in cultures of GAT-primed T cells and normal B cells. (HLW)

33906 Development of a photosynthesis model with an emphasis on ecological applications. III. Carbon dioxide and oxygen dependencies. Tenhunen, J.D.; Weber, J.A.; Filipek, L.H.; Gates, D.M. (Univ. of Michigan, Ann Arbor). *Oecologia (Berlin);* **30**: No. 3, 189-207(1977).

A theoretical description of the simultaneous processes of photosynthesis and photorespiration in a single leaf is developed, based on the hypothesis that carbon dioxide and oxygen compete for the active site of ribulose diphosphate carboxylase. Michaelis-Menten kinetics and competitive inhibition at the end of a diffusion path provide the basic structure of the model. Data of Ludwig (1972) from sunflower are analyzed according to the formulation. This description is part of a more general physiological-ecological model of photosynthesis presented previously (Tenhunen et al., 1976a,b) and continues to elaborate sub-processes in terms of physiologically meaningful parameters. The description is considered a working hypothesis. Data on photorespiration from the literature are reviewed as they relate to this working hypothesis. Several lines of investigation are thereby suggested that will help clarify the role of photorespiration in whole leaf photosynthesis and determine the over-all utility of this modeling approach.

PUBLIC HEALTH

REFER ALSO TO CITATION(S) 34008, 34022, 34023

AGRICULTURE AND FOOD TECHNOLOGY

REFER ALSO TO CITATION(S) 33196, 33198, 33212, 33215, 33216, 33997

33907 Effects of incubation and liming on yield and heavy metal uptake by rye from sewage-sludged soil. Lagerwerff, J.V.; Biersdorf, G.T.; Milberg, R.P.; Brower, D.L. (Agricultural Environmental Quality Inst., Beltsville, MD). *J. Environ. Qual.;* **6**: No. 4, 427-431(1977).

Rye (Secale cereale L., var. Balboa) was grown under controlled conditions on Evesboro sandy loam amended with digested secondary sewage sludge. Our purpose was to measure plant yield and uptake of Cd, Cu, Pb, and Zn as functions of sludge application rate (0 to 10 percent, dry weight basis), sludge origin (Baltimore, Md., and Washington, D.C.), pH of soil-sludge mixture (two levels), incubation time between mixing and planting (0 to 7 weeks), and plant age (three clippings). Plant yields from successive clippings decreased as sludge application rates increased. Uptake of the four metals increased with sludge additions and with plant age, in the order Zn greater than Cd greater than Pb approximately equal to Cu. Metal uptake decreased in the order Zn greater than Cd greater than Pb greater than Cu with addition of lime. Incubation considerably diminished Cu and Pb uptake. All observations point to organic matter complex formation in the order Cu greater than Pb greater than Zn greater than Cd. The relative uptake of HCl-extractable Cd from soil was greater than that of Zn, especially upon liming, while the total uptake of these metals then decreased.

BIOMEDICAL SCIENCES, APPLIED STUDIES

RADIATION EFFECTS

33908 "Biostack-2" experiment. Report 1. Design and composition of unit, methods of topological recording and identification of heavy nuclei of galactic cosmic radiation. Marennyi, A.M.; Popov, V.I.; Solyanov, B.I. (Inst. of Biomedical Problems, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 112-115(1977).

Translated from Radiobiologyiya; 17: No. 4, 559-562(1977).

A description is given of the assembly of a stack of dielectric track detectors alternating layers of biological objects, used for the study of the biological effects of heavy nuclei of galactic cosmic radiation on the Kosmos-690 biosatellite. A method is described for recording hits of heavy nuclei in biological objects and identification of particles passing through the stack.

RADIATION EFFECTS ON BIOCHEMICALS

IN VITRO

33909 Polarographic methods of investigation of radiochemical transformations of phenol compounds induced by gamma radiation. Norbaev, N. (Termez State Pedagogical Inst., USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 124-126(1977).

Translated from Radiobiologyiya; 17: No. 4, 569-571(1977).

Electron polarography was used for studies on radiochemical changes in phenol compounds following exposure to gamma radiation. The amount of quinones 3 to 4 h after irradiation increased in chlorogenic acid, pyrocatechol, and quercetin; the amount of quinones decreased 24 h after irradiation. (HLW)

IN MAN

33910 (SAND—77-1725) **Public protection strategies for potential nuclear reactor accidents: sheltering concepts with existing public and private structures.** Aldrich, D.C.; Ericson, D.M. Jr.; Johnson, J.D. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering; Sandia Labs., Albuquerque, N.Mex. (USA); New Mexico Univ., Albuquerque (USA). Dept. of Nuclear Engineering). Feb 1978. Contract EY-76-C-04-0789. 30p. Dep. NTIS, PC A03/MF A01.

Three generic sheltering/relocation strategies are identified and discussed. They are: population relocation only (no specific sheltering response initiated); sheltering at location following by relocation; and preferential sheltering followed by relocation. Shielding factors representative of these strategies are calculated, and the adequacy of using average shielding factors for the calculation of public health effects is discussed.

RADIATION EFFECTS ON CELLS

EXTERNAL SOURCE

REFER ALSO TO CITATION(S) 33941, 33964

33911 (UCD—472-124, pp 127) **In vitro irradiation of canine whole blood.** Shifrine, M.; Pomeroy, A.; Taylor, N.J.; DeRock, E.; Wiger, N.; Wilson, F.D. Oct 1977.

In Annual report, fiscal year 1977.

The effect of radiation was studied in subpopulations of lymphocytes specifically stimulated by phytohemagglutinin (PHA) or concanavalin A (CON A). Blood from five normal dogs was irradiated in vitro at different dose levels and then used in a WB/LST (Shifrine et al., UCD 472-124:105, 1977). The D_{37} for survival of PHA-stimulated lymphocytes was approximately 130 R whereas the D_{37} for the CON-A-stimulated lymphocytes was outside the upper limit of doses tested (Fig. 1). These data indicate the presence of at least two subpopulations of T-lymphocytes, with different sensitivities to radiation. Preliminary data from acute in vivo radiation of one dog also showed radiation resistance of a subpopulation of T-lymphocytes stimulated by CON A.

33912 (UCD—472-124, pp 128-130) **Radiation-survival studies on canine T-lymphocyte progenitors using in vitro cloning techniques: existence of radioresistant subpopulations in peripheral blood.** Wilson, F.D.; Shifrine, M.; Dyck, J.; Whaley, C.; Knox-Pillsbury, S. Oct 1977.

In Annual report, fiscal year 1977.

Preliminary studies on the dose-response characteristics for x-irradiation of canine peripheral lymphocyte progenitors showed the

presence of both radiosensitive (D_{37} approximately 70 R) and radioresistant (D_{37} approximately 130 R) subpopulations of lymphocyte progenitors. X-ray dose-response studies on peripheral blood lymphocytes obtained from beagles receiving continuous irradiation from a γ-source indicate that radioresistant components replace the sensitive populations.

33913 (UCD—472-124, pp 134) **Effect of chronic, continuous gamma irradiation on hematopoietic and stromal stem cells.** Knospe, W.H.; Adler, S.; Wilson, F.D.; Graham, R. Oct 1977.

In Annual report, fiscal year 1977.

The effects of continuous γ-irradiation at a dose rate of 40 R/day from the ^{60}Co source on hematopoiesis in CAF_1 mice are reported. In addition to quantitative effects on routine blood parameters, the effects on CFU-S, CFU-C and PFU-C were investigated for bone marrow and spleen responses. These direct comparisons of the effects of continuous irradiation on pluripotent and committed stem cells show that both CFU-S and CFU-C respond similarly, whereas PFU-C were more resistant to radiation.

33914 (UCD—472-124, pp 140-141) **Model for evaluation of radiotherapy of human tumors transplanted into nude mice.** Ikeda, R.M.; Shifrine, M.; Kawakami, T.G.; Gershwin, M.E. Oct 1977.

In Annual report, fiscal year 1977.

The purpose of the study was to determine the dose necessary to kill the tumor in vitro and then to extrapolate the data for in vivo radiotherapy. The congenitally athymic (nude) mouse, with an immunologic deficiency, that allows transplanted tumors to grow was used to determine the dose required to kill the tumor cells in vivo. A human endometrial carcinoma, maintained in continuous tissue culture, was serially passaged in nude mice for twenty generations. During this time, histology, karyotype, and latency period for tumor appearance remained basically unchanged. Because of this biologic stability, explants and single-cell suspensions of this tumor were irradiated in vitro and then transplanted to nude mice in an attempt to develop a suitable model for evaluation of therapeutic effectiveness. Latency period was shortest with the explant and was dependent on initial cell numbers with the single cell suspensions. The latency period of previously irradiated tumor cells was related directly to the radiation dose, but the growth rate was independent of dose: no tumor growth was observed after irradiation with 1750 R or more. Selective in vivo cloning of irradiated cells produced a radioresistant population, an aspect of radiotherapy that needs further study.

33915 Biophysical studies with high-energy argon ions. II. Determinations of the relative biological effectiveness, the oxygen enhancement ratio, and the cell cycle response. Hall, E.J.; Bird, R.P.; Rossi, H.H.; Coffey, R.; Varga, J.; Lam, Y.M. (College of Physicans and Surgeons of Columbia Univ., New York). *Radiat. Res.;* **70**: No. 3, 469-479(Jun 1977).

Chinese hamster cells cultured in vitro were used as a test system to investigate the radiobiological effects of 429 MeV/amu argon ions. Samples were irradiated at four positions in the depth dose profile. The first was located on the entrance plateau, the second on the ascending portion of the depth dose curve upstream from the Bragg peak, the third as close as possible to the Bragg peak, and the fourth on the "tail" beyond the peak. For a surviving fraction of 0.1, the relative biological effectiveness is about 2.4 for the plateau, ascending region, and the tail of the depth dose curve, and has a lower value of about 1.5 at the peak. The oxygen enhancement ratio is high, in excess of 2 in the incident plateau, and falls to about 1.3 close to the Bragg peak. Cells were irradiated with x rays or Bragg-peak argon ions at various times after synchronization with hydroxyurea. A 17-fold variation in survival through the cycle with x rays was reduced to a 2-fold variation with argon ions.

33916 Effect of extreme hypoxia and glucose on the repair of potentially lethal and sublethal radiation damage by mammalian cells. Koch, C.J.; Meneses, J.J.; Harris, J.W. (Victoria Hospital, London, Ontario). *Radiat. Res.;* **70**: No. 3, 542-551(Jun 1977).

Confluent monolayers of Chinese hamster ovary cells repaired potentially lethal x-ray damage under aerobic conditions but did not repair such damage under extremely hypoxic conditions. However, addition of extra glucose to the medium allowed some repair of potentially lethal damage by these hypoxic cells. Because of this effect of glucose, we repeated earlier experiments, which had shown that exponentially growing cells did not repair sublethal damage under extremely hypoxic conditions using both plateau-phase and exponentially growing cells. Two significant results were obtained under extremely hypoxic conditions, no repair of sublethal damage was observed, even at high glucose concentrations; under aerobic conditions, plateau-phase cells repaired sublethal damage more rapidly and more efficiently than did similarly treated exponentially growing cells. From these data we conclude that the oxygen and/or energy requirements are different for the repair of potentially lethal and sublethal damage.

33917 Determination of relative biological effectiveness (RBE) of soft x rays. Zeitz, L.; Kim, S.H.; Kim, J.H.; Detko, J.F. (Memorial Sloan-Kettering Cancer Center, New York). *Radiat. Res.;* **70**: No. 3, 552-563(Jun 1977).

Differences in clinical results reported with the use of iodine-125 encapsulated implants compared to those with gold-198, radon-222, and iridium-192 prompted a study of the RBE, relative to ^{60}Co γ radiation, of x rays simulating the spectral distribution of radiation from encapsulated ^{125}I. The parameter used for the RBE determination was the killing of surface-attached log-phase HeLa-S3 cells. The RBE was determined at dose rates varying from 15 to 130 rad/min which are about 90 to 500 times greater than those employed in therapy with interstitial ^{125}I implants. It was found to be approximately 1.4 when measured as a ratio of D_0's and 1.3 as determined on the basis of the ratio of doses for 10% survival (dose rates of 15 and 30 rad/min). The RBE values were found to be dose-rate dependent, increasing linearly from 130 to 30 rad/min and possibly leveling off below this point.

33918 Radiosensitization of hypoxic mammalian cells by diamide. II. Studies of mechanism. Harris, J.W.; Koch, C.J.; Power, J.A.; Biaglow, J.E. (Univ. of California, San Francisco). *Radiat. Res.;* **70**: No. 3, 585-596(Jun 1977).

Diamide [diazenedicarboxylic acid bis(N,N′-dimethylamide)] radiosensitizes hypoxic Chinese hamster cells by decreasing the shoulder of the survival curve (at low concentrations) and increasing the slope (at high concentrations). We studied the mechanisms responsible for these two phenomena by irradiating cells under different conditions of temperature and substrate availability and measuring either their survival or DNA damage (chromosome aberrations and strand breaks). The results confirm that different mechanisms are responsible for the two effects. The effect on the shoulder appeared to be due to oxidation of endogenous nonprotein sulfhydryls and reduced pyridine nucleotides, compounds that would normally effect rapid chemical repair of certain (single-hit type) lesions. The slope effect, on the other hand, may have been due to reactions with DNA similar to those that have been described for the electron-affinic compounds. These results, together with the finding that hypoxic cells remained sensitized after the removal of diamide when they were irradiated in the cold, provide a useful model and a new experimental approach to the question of chemical radiosensitization.

33919 Cellular basis of differences in radiosensitivity of different strains of mice. Konoplyannikov, A.G.; Maslennikova, R.L. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 58-64(1977).

Translated from Radiobiologyiya; 17: No. 4, 515-519(1977).

A comparison of data pertaining to quantity and radiosensitivity of cells of the stem type in hemopoietic tissues of BALB/c and CBA mice, which differ in overall radiosensitivity ($LD_{50/30}$ constitutes 579 and 761 rad, respectively), failed to demonstrate any appreciable differences. Investigation of the rate of recovery of CFU [colony forming unit] population, dynamics of cellularity of hemopoietic organs and amount of peripheral blood leukocytes in these strains of mice led to the conclusion that the greater radioresistance of CBA mice is based on faster proliferation of stem cells following irradiation of the animals.

33920 Effect of complement on postradiation hemolysis of erythrocytes. Ivanov, A.A.; Mozhaiskii, A.M. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 139-141(1977).

Translated from Radiobiologiya; 17: No. 4, 581-583(1977).

Erythrocyte suspensions from guinea pig blood were exposed to gamma radiation and divided into two parts. Active serum was added to one part and inactivated serum was added to the second part. The intensity of hemolysis was determined by means of a photoelectric colorimeter. There was a progressive increase in intensity of hemolysis with the increase of radiation dose from 150 to 500 k rad and hemolysis was more intense in active serum than in inactivated. The significance of the results is discussed. (HLW)

33921 Characteristics of stromal colony-forming cells of human bone marrow in the presence of lymphogranulomatosis. Rudakova, S.F.; Baisogolov, G.D.; Pavlov, V.V. (Scientific Research Inst. of Medical Radiology, Obninsk). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 175-179(1977).

Translated from Radiobiologiya; 17: No. 4, 609-612(1977).

Bone marrow was removed from the sternum or ilium of patients with lymphogranulomatosis and exposed to gamma radiation. Irradiated and nonirradiated suspensions were used for explantation. The effectiveness of colony formation was estimated according to the number of colonies formed per 10^6 explanted cells. The curves of survival of colony-forming bone marrow cells as a function of radiation dose were close to exponential in patients with active disease and in those with remission. Changes in bone marrow cells indicated transformed colony-producing cells in bone marrow of patients with an active disease. (HLW)

33922 Investigation of feasibility of using mexamine for postradiation protection of L cells. Val'ter, S.N.; Martynchik, Yu.F.; Sverdlov, A.G. (Leningrad Inst. of Nuclear Physics). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 189-192(1977).

Translated from Radiobiologiya; 17: No. 4, 620-623(1977).

Suspension of L cells were exposed to gamma radiation; mexamine was added before and after irradiation. Effects of caffeine on cells were also studied. Observations were made on survival time, colony formation, and chromosomal aberrations. When mexamine was administered before irradiation a protective effect was demonstrated, but when added after irradiation there was no protective effect. Caffeine did not have a protective effect. (HLW)

RADIATION EFFECTS ON MICROORGANISMS

BASIC STUDIES

REFER ALSO TO CITATION(S) 33941, 33948

33923 Patterns of radiorace formation in yeast organisms. Report 11. Facts and hypotheses. Korogodin, V.I.; Bliznik, K.M.; Kapul'tsevich, Yu.G. (All-Union Scientific Research Inst. of Genetics and Breeding of Commercial Microorganisms, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 30-39(1977).

Translated from Radiobiologyiya; 17: No. 4, 492-499(1977).

A hypothesis is expounded to explain the patterns of radiation-induced race formation in yeast. According to this hypothesis, the same primary lesions that elicit the lethal effect play the leading role in radiorace formation. Each such injury is absolutely lethal to haploid cells. In diploid cells, each injury elicits a lethal effect only with a certain degree of probability. The effects of different injuries are cumulative. If the cell sustains no damage, it will survive and originate a clone that does not differ from the control. If a cell sustains one or several injuries, it either perishes or originates a mutant or unstable clone. The greater the number of injuries in the original irradiated cell, the greater the instability of the clone; with a large enough number of injuries, all offspring of the irradiated cell perish. The lesions that have the above properties are most likely major chromosomal aberrations.

33924 Some patterns of postradiation recovery of Escherichia coli bacteria. Morozov, I.I.; Korogodin, V.I. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 40-45(1977).

Translated from Radiobiologyiya; 17: No. 4, 500-504(1977).

Methods of serial dilutions and keeping cells in saline with high concentrations of suspensions were used to investigate recovery of viability of uv-irradiated E. coli bacteria (B, B/r, B/sub S-1/ strains). The property of postradiation recovery was not demonstrated in B/sub S-1/ and B/r. The recovery dynamics of strain B cells can be described by the equation, D/sub t/ = D_0[k+(1-k)e/sup -βt/]; for radiation doses of 120 and 480 erg/mm^2, irreversible component k = 0.20 and 0.12, while recovery rate β = 0.77 and 0.82 h^{-1}, respectively (6 h incubation, 37°C temperature). Consequently, under such experimental conditions, the rate of recovery of E. coli B. is unrelated to radiation dose.

33925 Effects of ionizing radiation on conjugation of E. coli K-12 (HfrxF$^-$) bacteria. Report 3. Effects of neutron and alpha particle radiation. Relative biological effectiveness. Troitskii, N.A.; Dromashko, S.E.; Novitskaya, M.A.; Baturo, V.A.; Okulich, L.A. (Inst. of Genetics and Cytology, Minsk). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 52-57(1977).

Translated from Radiobiologyiya; 17: No. 4, 510-514(1977).

A study was made of the effects of intermediate and fast neutrons and α-particles on recombination of E. coli, on the basis of a previously proposed mathematical model. It was shown that irradiation of the donor increases the probability of inclusion of the leading edge of the transmitted chromosome, recombination and prevention of transfer. The maximum recombinogenic effect is induced by 0.2 MeV neutrons; 1 MeV neutrons and α-radiation are less effective. On the basis of the submitted results, it may be assumed that primary single-stranded DNA breaks are not the cause of intensification of genetic processes in the zygote following the crossover.

33926 Mathematical modeling of some radiobiological effects as function of linear energy transfer. Gubin, A.T.; Kovalev, E.E.; Sakovich, V.A. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 101-111(1977).

Translated from Radiobiologyiya; 17: No. 4, 550-558(1977).

A method is offered for analysis of experimental data on radiosensitivity of single-hit objects as function of LET and type of particles, which is based on the use of microdosimetric characteristics within the framework of a general single-target model. The use of this method for analysis of data on yield of inactivation of some enzymes and bacteriophages, as well as E. coli B, made it possible to establish the following for these objects: the dependence of probability of inactivation on specific energy within the sensitive range can be approximated by the function, G(z) = 1-e/sup -az-βz^2/; the distinctive changes in radiosensitivity in the range of high LET are attributable to the effect of delta electrons; the contribution of delta electrons is approximately proportionate to the share of energy carried by delta electrons beyond the sensitive region in the case of direct heavy ion hits.

RADIATION EFFECTS ON PLANTS

BASIC STUDIES

REFER ALSO TO CITATION(S) 33941

33927 Biophysical studies with high-energy argon ions. III. Chromosomal aberrations in aerated and hypoxic Vicia faba root meristems. Geard, C.R.; Rossi, H.H. (Columbia Univ., New York). *Radiat. Res.;* **70**: No. 3, 480-493(Jun 1977).

Aerated and hypoxic primary roots of Vicia faba were irradiated in the entrance plateau and at the peak of the depth dose profile of 429 MeV/amu argon ions. Roots were sampled sequentially after irradiation and the spectrum and nature of chromosomal changes recorded on a per cell basis. Plateau irradiation resulted in more cells damaged per rad than Bragg peak irradiation, i.e., the RBE was lower at the Bragg peak. There was a substantial cell age sensitivity for aberration frequency for plateau exposure but much less so at the Bragg peak. For exposure at both depth dose positions the oxygen enhancement ratio was similar and high. Irradiation at the Bragg peak resulted in higher frequencies of incomplete and complex aberrations than plateau irradiation. These manifestations of the passage of highly energetic argon ions doubtless contribute to the "overkill" capacity of Bragg-peak irradiation. While RBE and OER at the peak were comparatively low and high, respectively, if total cells were considered; "hit" cells were often grossly damaged, possibly indicating a higher RBE and a lower OER for those particular cells. Microdosimetric analysis is necessary before the distribution of energy deposition events at the nucleus level can be related to the distribution of observable cytological events.

33928 Homology of rRNA-DNA of the cotton plant under normal conditions and following exposure to gamma radiation. Ibragimov, A.P.; Rakhmatov, N.A.; Ilsmailov, E.M.; Usmanov, T.A. (Inst. of Biochemistry, Tashkent, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 135-138(1977).

Translated from Radiobiologyiya; 17: No. 4, 578-581(1977).

Seedlings of Gossypium hirsutum were exposed to gamma radiation and incubated for 24 h. Ribosomes were isolated by ultracentrifugation and molecular hybridization of DNA with RNA was performed using nitrocellulose filters. Radiation decreased hybridization and it is believed that synthesis of RNA was blocked. The radioinduced changes in structure and function of DNA cause impaired synthesis of different RNAs. Following irradiation there is a change in activity of cistrons that code 80S RNA and ribosomal proteins in the cotton plant. (HLW)

33929 Investigation of the effects of relatively low doses of gamma rays (cobalt-60) on polyphenoloxidase activity in tomato seeds. Daskalov, C.; Moynova, K.; Maltseva, S. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 149-150(1977).

Translated from Radiobiologiya; 17: No. 4, 589-590(1977).

Tomato seeds were exposed to gamma radiation in doses of 2 to 16 kR and polyphenoloxidase activity was determined. Results indicated a significant increase in enzyme activity with a 2 kR dose and diminished activity with increasing doses. Graphs are presented to show dose-response relationships. (HLW)

33930 Effect of synchrotron radiation on Nicotiana tabacum L. seeds. Avakyan, T.M.; Karagezyan, A.S.; Danielyan, A.Kh.; Batikyan, G.G. (Erevan Inst. of Physics). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 197-199(1977).

Translated from Radiobiologiya; 17: No. 4, 626-628(1977).

Seeds of Nicotiana tabacum were exposed to an SR beam. The dose rate was determined by measuring the number of particles accelerated in the orbit of the accelerator. Seeds were also exposed to x radiation. Following irradiation the seeds were allowed to germinate and root tips were prepared for microscopic examination. Results showed that synchrotron radiation produced many more aberrant cells than x radiation. Mitosis was completely inhibited 3 days following synchrotron radiation. (HLW)

RADIATION EFFECTS ON ANIMALS

MAN

REFER ALSO TO CITATION(S) 34114

33931 (AD—045139) **Acute radiation sickness: the prodromal syndrome, an annotated bibliography. Special publication.** Middleton, G.R. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Feb 1977. 34p. NTIS PC A03/MF A01.

This report is an annotated bibliography of acute radiation sickness and the prodromal syndrome. It also includes reports on radiation accidents, experimental studies containing data relevant to postirradiation vomiting and reviews of the clinical treatment of acute radiation injury. An author index is provided. (Author)

33932 (NUREG—0419) **Occupational radiation exposure at NRC-licensed facilities, 1975.** Cool, W.S. (Nuclear Regulatory Commission, Washington, D.C. (USA). Office of Standards Development). Jan 1978. 38p. NTIS $4.50.

By letter dated August 25, 1976, licensees of the Nuclear Regulatory Commission were requested to submit, as a voluntary one-time action, a statistical summary report of whole-body personnel monitoring results for their activities during 1975. This report presents these personnel monitoring data in the form of tables and log-probability plots that facilitate evaluation and comparison of the data. Licensee estimates of the effort (man-hours and total cost) expended in preparing the statistical summary report are also presented.

VERTEBRATES

33933 (UCD—472-124) **Annual report, fiscal year 1977.** (California Univ., Davis (USA). Radiobiology Lab.). Oct 1977. Contract EY-76-C-03-0472. 234p. Dep. NTIS, PC A11/MF A01.

Separate abstracts were prepared for the 55 papers of the report. An author index and appendices giving experimental designs, personnel, and publications are included. (HLW)

33934 (UCD—472-124, pp 84-87) **^{60}Co dog dosimetry.** Bradley, E.W.; Goldman, M. Oct 1977.

In Annual report, fiscal year 1977.

A summary of computed ^{60}Co dosimetry is presented. Studies did not prove conclusively the accuracy of present methods of computing the exposure to the dogs in the ^{60}Co field by x-ray cross calibration. Current studies will further analyze our methods and establish the validity of our data.

33935 (UCD—472-124, pp 88-94) **Overview of gamma ray leukemogenesis study.** Wilson, F.D.; Stitzel, K.A.; Macias, T. Oct 1977.

In Annual report, fiscal year 1977.

Results obtained for the ^{60}Co leukemogenesis study are reviewed. To date, of the 26 weanling beagles placed at the 2.20 R/day and 11.37 R/day levels and allowed to remain at least to 130 days of age, 7 animals have manifested bone marrow aplasia as of May 31, 1977. The responses of peripheral blood and bone marrow to continuous irradiation are presented including the effects on myeloid and lymphoid progenitors using in vitro cloning assays.

33936 (UCD—472-124, pp 95-96) **Induction of radiation-induced aplasia in weanling beagles with continuous whole-body ^{60}Co γ-irradiation.** Wilson, F.D.; Stitzel, K.A. Oct 1977.

In Annual report, fiscal year 1977.

The results of preliminary studies on radiation-induced aplasia in weanling beagles, when compared with those for adult beagles at Argonne National Laboratory, imply a susceptibility of young beagles to radiation-induced hematopoietic damage at least twice that of adults. In addition, bone marrow cellularity and hematopoietic progenitor populations are reduced greatly in animals manifesting with bone marrow aplasia.

33937 (UCD—472-124, pp 100) **Effect of low-level chronic ^{60}Co radiation on cell mediated immune status of the dog.** Shifrine, M.; Taylor, N.J.; DeRock, E.W.; Wiger, N.; Wilson, F.D.; Stitzel, K.A.; Visser, T. Oct 1977.

In Annual report, fiscal year 1977.

One of the specific goals of the ^{60}Co experimental hematology-immunology program is to assess the immune response of irradiated dogs and to relate this response to subsequent induced neoplasias. We have used the lymphocyte stimulation test (LST) to measure the cell mediated immune (CMI) response of dogs in all radiation levels (cf. appendix B) about once every 6 weeks. Blood from some of the dogs also was teated using the whole blood LST (WB/LST), which was developed during the course of this study. To date the four control (COO) dogs have shown no change. One dog, in the C2O group, which has received approximately 40 rads, showed a decreased immune response as indicated by the WB/LST only; two others at this level showed an equivocal response, and one remained normal. In the C30 group, one dog showed reduced CMI, and three remained normal. These dogs have received a cumulative exposure of approximately 80 R to date. A similar pattern of response has been noted in the C40 group of 4 dogs, which have received approximately 400 R to date. Neither the four C50 dogs, with a cumulative exposure of approximately 100 R, nor the two C60 dogs that survived a cumulative dose of 500 and 1000 R showed changes in immunologic reactivity.

33938 **Effects of whole-body x irradiation on the biogenesis of creatine in the rat.** Thyagarajan, P.; Vakil, U.K.; Sreenivasan, A. (Bhabha Atomic Research Center, Bombay). *Radiat. Res.;* **70**: No. 3, 519-529(Jun 1977).

Influences of whole-body x irradiation on various aspects of creatine metabolism have been studied. Exposures to sublethal or lethal doses of x radiation results in excessive urinary excretion as well as higher accumulation of creatine in the skeletal muscle of x-irradiated rats. A sudden fall in CPK activity in muscle with a concomitant rise in serum suggests that changes in serum and tissue CPK activity are of an adaptive nature in rats exposed to sublethal doses of x radiation. In vitro studies on creatine synthesis shows that transaminidase and methyl transferase activities in kidneys and liver, respectively, are decreased on the 5th day in the x-irradiated, are decreased on the 5th day in the x-irradiated rat. However, on the 8th day, the enzyme activities are restored to normal.

33939 **Fine-structural effects of 1200-R abdominal x irradiation on rat intestinal epithelium.** Lieb, R.J.; McDonald, T.F.; McKenney, J.R. (Medical Coll. of Georgia, Augusta). *Radiat. Res.;* **70**: No. 3, 575-584(Jun 1977).

Male Charles River CD rats were shielded from the xiphoid process cranially with lead and were exposed to 1200-R abdominal x irradiation. Animals were sacrificed at 1 through 4 days following irradiation and tissues from both ileum and jejunum were prepared for electron microscopic examination. At the fine-structural level early changes were confined to a proliferation and dilation of smooth endoplasmic reticulum and to an increase in the number of lysosomes. At 4 days postirradiation, cells covering the villi were cuboidal rather than columnar and appeared to be immature crypt-type cells. The appearance of these cells was coincident with the onset of diarrhea in these animals.

33940 **Suppressor T cells in tolerance to non-self and self antigens.** Basten, A.; Loblay, R.; Chia, E.; Callard, R.; Pritchard-Briscoe, H. (Univ. of Sydney). *Cold Spring Harbor Symp. Quant. Biol.;* **41**: 93-103(1977).

From Cold Spring Harbor symposium on quantitative biology; Cold Spring Harbor, NY, USA (Jun 1976).

An experimental model is described for suppressor T cells in tolerance to non-self and results are discussed with regard to: specificity of suppression at the induction phase; cross-reactivity of suppression vs. help; effector cells mediating suppression; precursors of cells mediating suppression; suppression as an active process; and target cell for suppression. A model is described for suppressor cells in tolerance to self and results are discussed with regard to capacity of normal lymphoid cells to abrogate the anti-hapten response to DNP.Tg and effect the transfer of thyroglobulin and DNP.Fla-primed cells into nonirradiated normal, carrier-primed, or hapten-primed recipients. (HLW)

33941 (DOE-tr—4/4) **Radiobiology.** Translation of *Radiobiologiya;* **17**: No. 4, 467-640(1977). 216p. Dep. NTIS, PC A10/MF A01.

Available from NTIS for $45.00 per year (six issues) as NTISUB C 120 001.

Separate abstracts were prepared for the 40 papers included in this English translation of Radiobiology. (HLW)

33942 **Effect of exogenous DNA on synthesis and quantity of DNA in tissues of animals exposed to fast neutrons.** Chebotarev, E.E.; Ryabova, E.Z.; Gushcha, K.P.; Indyk, V.M. (Inst. of Oncological Problems, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 1-8(1977).

A study was made of the effect of exogenous DNA on synthesis and quantity of DNA in tissues of rats exposed to fast neutrons. It was established that exogenous DNA does not affect synthesis of cellular DNA at the early postradiation term. The intensity of DNA synthesis in the cells studied increases at the later stages, due to increased radioresistance of tissues, which results in lesser radiation damage.

33943 **Early radiation-induced impairment of RNA biosynthesis in some organs of irradiated rats.** Skotnikova, O.I.; Nelipovich, P.A.; Umanskii, S.R.; Tokarskaya, V.I. (Inst. of Biological Physics, Pushchino, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 9-15(1977).

Translated from Radiobiologiya; 17: No. 4, 474-479(1977).

A study was made of RNA synthesis in the liver, thymus and spleen of rats 30, 60 and 120 min after exposure to radiation (dosage of 800 R). It was shown that there is an increase in synthesis of nuclear RNA in the liver and spleen 30 min after irradiation. By the 2d postradiation hour, RNA synthesis is totally normalized in hepatic cells and partially normalized in the spleen. There is a greater increase in synthesis of precursor of ribosomal RNA than synthesis of giant nuclear RNA in the liver 30 min after irradiation. The changes in synthesis of nuclear RNA are less marked in the thymus.

33944 Radiation lesion to lymphoid tissue delayed under the influence of inhibitors of protein synthesis. Ermolaeva, N.V.; Vodolazskaya, N.A. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 16-21(1977).

Translated from Radiobiologiya; 17: No. 4, 480-484(1977).

A study was made of the effect of protein synthesis inhibitors (cycloheximide and puromycin) on decree of DNP breakdown in the thymocytes of irradiated rats and thymus of mice 50-10 h after exposure to γ-radiation in a dosage of 600 R. It was demonstrated that both inhibitors have a marked inhibitory effect on in vitro degradation of DNP. In experiments on mice, multiple injections of cycloheximide in a dosage of 1 to 2 mg/kg elicited temporary inhibition of DNP degradation.

33945 Ontogenetic aspects of effects of different doses of gamma rays on levels of lactate dehydrogenase isozymes in rat tissues. Surinov, B.P. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 22-29(1977).

Translated from Radiobiologyiya; 17: No. 4, 485-491(1977).

A comparative study was made of the effects of different doses of ^{60}Co γ-rays (100 to 15,000 rad) on levels of LDH isozymes in tissues of adult rats, as well as changes in activity thereof in the 10 to 25 days after birth. Differences were demonstrated in the effects of various doses of γ-rays, with no correlation between radiosensitivity of tissues and impaired isozyme composition, but with correlation to dynamics of isozyme content in the neonate period. The postradiation disturbances correspond to partial loss of tissular specificity of LDH isozyme composition, and they are probably due to metabolic changes.

33946 Serological activity of immunoglobulin G in irradiated rabbits. Ivanov, A.A.; Nevinnaya, A.P.; Mozhaiskii, A.M.; Snisar, N.A. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 46-51(1977).

Translated from Radiobiologyiya; 17: No. 4, 505-509(1977).

A comparative study was made of serological immunochemical properties of immunoglobulins (IgG) isolated from blood serum of normal rabbits and rabbits exposed to lethal and median lethal doses of radiation. It was demonstrated that there is a distinct elevation of IgG level in the period of recovery from radiation sickness, with increase at this time in complement-binding antitissular antibodies in IgG, increase in anticomplement activity and rate of IgG catabolism in the normal organism.

33947 Mechanism of action of ionizing radiation on hexokinase and cholinesterase activity in the rat brain, in the presence of altered function of M-cholinergic structures. Khripchenko, I.P.; Kukulyanskaya, M.F.; Markina, V.L.; Panina, T.I. (Belorussian State Univ., Minsk). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 65-69(1977).

Translated from Radiobiologyiya; 17: No. 4, 520-523(1977).

Data are submitted on activity of hexokinase and isozymes thereof, and cholinesterase in subcellular fractions of the brain in the case of inhibition and stimulation of M-cholinoreactive structures under the influence of a relatively small dose, 40 R, of ionizing radiation.

33948 Analysis of changes in intestinal microflora of irradiated mice. Mal'tsev, V.N.; Pinegin, B.V.; Korshunov, V.M. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 70-76(1977).

Translated from Radiobiologyiya; 17: No. 4, 524-529(1977).

In experiments on 3 groups of CBA mice exposed to doses of 900, 600 and 300 R γ-rays, it was demonstrated that the integral severity of post-radiation microflora in the intestine can be determined by means of information index h, which takes into consideration all changes occurring in different representatives of the intestinal microflora. Differential analysis of the mechanisms of radioinduced changes in microflora indicates that it is based on a decrease in lactobacilli and increase in enterococcus, proteus, colibacillus and yeast in the small intestine, with increase in colibacillus, clostridia, proteus and enterococcus in the large intestine.

33949 Effect of spleen extract on irradiated mice. Olontseva, O.I.; Moroz, B.B.; Kerova, N.I. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 83-89(1977).

Translated from Radiobiologyiya; 17: No. 4, 536-540(1977).

Extracts were obtained with saline and trishydrochloric buffer with 1 M glycine from the spleen of healthy mice. Extraction with tris-hydrochloric buffer, pH 7.5, revealed that the extract had a stable, stimulating effect on recovery of medullary hemopoiesis and mouse survival. It is assumed that the biological activity of the spleen extract is related to components of the nuclease-inhibiting complex.

33950 Patterns of postradiation recovery of the organism from exposure to nonuniform external radiation. Report 2. Postradiation recovery of rats from oral radiation lesion. Zaitseva, R.N.; Avetisov, G.M. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 90-94(1977).

Translated from Radiobiologyiya; 17: No. 4, 541-544(1977).

This article submits the curve of residual lesion in the oral form of radiation sickness in rats, which was obtained by the method of two-fold exposure of the head to 250 kV x-rays.

33951 Radiosensitivity of common redbacked voles inhabiting different geographic regions of European USSR. Il'enko, A.I.; Mazheikite, R.B.; Nizhnik, G.V.; Ryabtsev, I.A. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 95-100(1977).

Translated from Radiobiologyiya; 17: No. 4, 545-549(1977).

A study of radiosensitivity of common redbacked voles (Clethrionomys glareolus) revealed that they are among the most radioresistant species of wild rodents ($LD_{50/30}$ is 966 R). A study of the yield of chromosomal aberrations in somatic cells of nonirradiated animals and those exposed to a dose of 200 R radiation established equal radiosensitivity, according to this criterion as well, of vole populations inhabiting different geographic regions of European USSR.

33952 Equipment and dosimetry for radiobiological experiments with the IRT-2000 atomic reactor. Voskresenskii, V.V.; Mikhailov, A.L.; Litskevich, L.A.; Stukanov, S.L.; Dokshina, G.A. (Scientific Research Inst. of Biology and Biophysics, Tomsk, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 116-120(1977).

Translated from Radiobiologyiya; 17: No. 4, 563-566(1977).

A description is given of the distinctive features of design and equipment of the biological channel of the IRT-2000 atomic reactor. A study was made of spectrometric and dosimetric characteristics of a guided ["channeled"] beam of mixed gamma and neutron radiation. It was demonstrated that mixed gamma and neutron fields can be obtained with virtually any contribution of neutron component to the total dose. Determination was made of survival of mice exposed to gamma and neutron fields varying in dosage of each component.

33953 Investigation of methylation of various tissue proteins following x-irradiation. Vinogradova, R.P.; Litvinenko, A.R. (Kiev State Univ.). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 121-123(1977).

Translated from Radiobiologyiya; 17: No. 4, 567-569(1977).

Methylation of the proteins of the liver, brain, and skeletal muscles and aminoacyl-t-RNA synthetase of the liver was investigated following a lethal dose of x rays to rats. Results demonstrated that irradiation of the animals led to impaired methylation of all proteins; administration of nicotinic acid before irradiation normalized methylation of ARSases, while administration of proserine had no normalizing effect. (HLW)

33954 Structural changes in myelokaryocyte chromosomes at the late postradiation stage in DNA-treated rats. Nikolaevskaya, N.G.; Muksinova, K.N. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 127-131(1977).

Translated from Radiobiologyiya; 17: No. 4, 572-576(1977).

Rats were exposed to 840 R of gamma radiation and 24 h later homologous or heterologous DNA was given to the exerimental group. The animals were killed at intervals up to 18 months later and cytological preparations were made from bone marrow. The bone marrow of rats treated with DNA did not show significant differences in polyploidy or aneuploidy as compared to untreated rats. However, the percentage of chromosomal aberrations was significantly lower in rats treated with DNA. The relationship of chromosomal aberrations to severity of pathological changes in hematopoietic tissues is discussed. (HLW)

33955 Transmembrane transport of sodium ions in irradiated polycellular membranes. Vepkhvadze, R.Ya.; Mtskhvetadze, A.V.; Sanaya, T.V.; Kotariya, R.Z.; Zil'bershtein, N.M. (Scientific Research Inst. of Medical Radiology, Tbilisi, USSR). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 132-134(1977).

Translated from Radiobiologyiya; 17: No. 4, 576-578(1977).

Studies were conducted to determine whether the radioprotective effect of certain substances was related to their influence on radiation-impaired transport of sodium in cell membranes. An area of the frog abdomen was x-irradiated following administration of cystamine. The concentration of sodium ions on both sides of the skin was assayed by means of sodium-selective electrodes. Graphs are presented to show changes in concentration of sodium ions on external and internal surfaces of frog skin 1 h after irradiation. Results showed that the concentration of sodium ions increased after irradiation. Preliminary administration of cystamine further increased the concentration of sodium ions in focal regions. (HLW)

33956 Effect of x rays on levels of some polyamines in the rat liver and thymus. Voskoboinikov, G.V.; Khanson, K.P. (Central Scientific Research Inst. of Roentgenology and Radiology, Leningrad). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 142-144(1977).

Translated from Radiobiologiya; 17: No. 4, 583-586(1977).

Rats were exposed to total-body x radiation in a dose of 1000 rad. Four migration zones of polyamines were revealed by electrophoretograms. Three of the zones were identified as spermine,

spermidine, and putrescine. Results indicated that radiation did not affect the levels of polyamines in the liver or thymus. Assay of polyamines in the liver following partial hepatectomy revealed a significant increase in spermidine in the regenerating liver with no change in spermine content. (HLW)

33957 Role of endogenous serotonin in the radioprotective effect of some amino thiols. Sverdlov, A.G.; Pavlova, L.M. (Leningrad Inst. of Nuclear Physics). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 145-148(1977).

Translated from Radiobiologiya; 17: No. 4, 586-588(1977).

Cystamine and N', N'-tetramethylcystamine were administered intraperitoneally to mice 20 and 60 min before x irradiation. Levels of serotonin in blood and tissues were increased. A graph is presented to show the radioprotective efficacy of cystamine and its analogue. A correlation could not be demonstrated between the radioprotective activity of cystamine and its analogue on the one hand, and their effects on the levels of endogenous serotonin in the small intestine and spleen on the other. (HLW)

33958 Investigation of the mechanism of radioprotective activity of 2-amino-5,6-dihydro-4H-1,3-thiazine, 4-methyl- and 2-amino-2-thiazoline hydrobromides. Mandrugin, A.A.; Konstantinova, M.M.; Nekrasova, I.V.; Tarasenko, A.G. (Moscow State Univ.). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 151-153(1977).

Translated from Radiobiologiya; 17: No. 4, 590-592(1977).

Mice were exposed to 900 R of gamma radiation; hydrobromides were given subcutaneously 30 min before irradiation. Determinations were made of oxygen tension in the spleen and liver and thiol content of the spleen. A comparison of the effects of hydrobromide on radioresistance and oxygen level in tissues indicated that the radioprotective activity was not attributable to the oxygen effect. The level of thiols in the spleen was not affected by the radioprotective compounds. (HLW)

33959 Radioprotective effects and toxicity of some mono- and bis-quaternary ammonium compounds. Vladimirov, V.G.; Parfenov, A.I.; Strel'nikov, Yu.E.; Slavachevskaya, N.M. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 154-157(1977).

Translated from Radiobiologiya; 17: No. 4, 593-596(1977).

Rats were exposed to 750 R of gamma radiation; ammonium compounds were given intraperitoneally 30 min prior to irradiation. Radioprotective effects were determined by the 30-day survival test. A table is presented to show relationships between survival and chemical structure of the different compounds and a discussion is given of this relationship. (HLW)

33960 Radioimmunological study of regulation of insulin secrtion in the presence of acute radiation sickness. Barkalaya, A.I. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 158-161(1977).

Translated from Radiobiologiya; 17: No. 4, 596-599(1977).

Rats were exposed to 750 R of gamma radiation and one group was given insulin subcutaneously during the period of hypercorticoidism and hyperglycemia. Rats were killed at intervals up to 10 days after irradiation and insulin was determined by radioimmunoassay. A table is presented to show effects of radiation on levels of corticosterone, glucose, and insulin at daily intervals. Results indicate that insulin optimizes carbohydrate metabolism and protects the insulin system from stress during radiation sickness. (HLW)

33961 Role of thiols in species-specific differences in radiosensitivity of mammals. Graevskaya, B.M.; Ivanenko, G.F.; Gromova, A.V. (Inst. of Morphology and Ecology of Animals, Moscow). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 162-165(1977).

Translated from Radiobiologiya; 17: No. 4, 599-602(1977).

Rats, mice, voles, hamsters, and guinea pigs were exposed to whole-body x radiation and thiols were assayed in spleen, liver, and bone marrow by means of spectrophotometry. A table is presented to show thiol content of the tissues following an LD_{50} dose. The content of thiols was highest in the liver and lowest in the bone marrow. Various factors obscured the relationship of thiol content to inter-specific differences in radiosensitivity. (HLW)

33962 Reactions of autonomic nervous system neurons to radiation. Tkachenko, Z.Ya.; Demidova, G.G.; Chebotarev, E.E.; Gushcha, K.P. (Inst. of Molecular Biology and Genetics, Kiev). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 166-170(1977).

Translated from Radiobiologiya; 17: No. 4, 602-606(1977).

Rabbits were exposed to 300 R of x radiation and histological examinations were made of the nerve tissues of the solar plexus, stomach, and ileocecal region. Lysis of cell membranes, mitochondria, and ribosomes, pyknosis, edema, vacuolization, and other pathological changes are described nd photographs of abnormal tissues are presented. (HLW)

33963 Impairment of processes of digestion and absorption of nitrous products in the intestine of dogs with acute radiation sickness. Lyashchenko, Yu.N. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 171-174(1977).

Translated from Radiobiologiya; 17: No. 4, 606-608(1977).

Radiation sickness was induced in dogs by administering gamma radiation in a dose of 300 R. Digestion and absorption were studied in an isolated loop of small intestine. Chyme was perfused from a healthy donor animal to fasting dogs. Following irradiation profound disturbances in the processes of digestion and absorption occurred. The most significant changes were noted in the digestion of chyme proteins. (HLW)

33964 Effect of DNA on the pool of hemopoietic stem cells exposed to radiation in vitro. Shvets, V.N. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 180-184(1977).

Translated from Radiobiologiya; 17: No. 4, 613-616(1977).

Mice were exposed to a 950 R dose of gamma radiation and bone marrow removed from femurs of intact donors was exposed in vitro to 100 to 600 R radiation. DNA from calf thymus was added to the cell suspension. Nine days after transplantation the spleen and femurs of recipients were removed and histological examinations were made. The presence of DNA failed to intensify or diminish the capacity of stem cells to form colonies. It was concluded that the presence of DNA did not lead to a change in properties of the stem cell population. (HLW)

33965 Ultrastructure of the chick embryo thyroid following preincubation exposure to low doses of ionizing radiation. Khakimov, P.; Murtazaeva, L.M. (Inst. of Biochemistry, Tashkent). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 185-188(1977).

Translated from Radiobiologiya; 17: No. 4, 616-619(1977).

Thyroids of chick embryos were exposed in the preincubation period to 3 R of gamma radiation and at intervals up to 20 days later thyroid tissue was prepared for electron microscopy studies. There was a prevalence of large nuclei with hypertrophied nucleoli in the thyroid cells. With age the size of the nuclei diminished and the volume of cytoplasm increased. Changes in Golgi apparatus, mitochondria, and other cell constituents are described. Thyroid cells of irradiated embryos were characterized by faster differentiation of intracellular organelles. (HLW)

33966 Fluid metabolism changes in the presence of various forms of acute radiation sickness. Tsyran, N.I.; Sveshnikov, A.A.; Nesterenko, V.S. (Scientific Research Inst. of Medical Radiology, Obninsk). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 193-196(1977).

Translated from Radiobiologiya; 17: No. 4, 623-626(1977).

Acute radiation sickness was induced in rats by 700 to 1000 R doses of gamma radiation. Fluid metabolism was examined 24, 48 and 72 h later. A table is presented to show changes in total extracellular, intracellular, and intravascular fluid levels. One day after irradiation there was a decrease in total fluid content, intracellular, and intravascular fluid, and an increase in extracellular fluid. Two days after irradiation, there was an increase in total fluid. After 72 h, dehydration developed with a continuous decrease in intravascular fluid. The relationships of these changes to pathological changes are discussed. (HLW)

RADIONUCLIDE EFFECTS - INTERNAL SOURCE

MAN

33967 Radiotoxicological monitoring of the personnel in the Pierrelatte uranium isotope separation plant: methods and results. Chalabreysse, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service d'Etudes et Recherches sur l'Environnement). pp 45-48 of Proceedings of the 4. International congress of the International Radiation Protection Association. Paris, 24-30 April 1977. Fontenay-aux-Roses, France; Association Internationale de Protection contre les Rayonnements (1977). (In French)

From 4. congress of the International Radiation Protection Agency; Paris, France (24 Apr 1977).

See CONF-770409—.

In a uranium isotope gaseous diffusion separation plant, such as the one at Pierrelatte, there are very different compounds of a chemical nature and isotopic composition, which notably complicates the personnel monitoring; those most liable to be inhaled or ingested are indicated. Their difference forms of toxicity are studied. The radiotoxicological surveillance techniques developed and employed at Pierrelatte in the past 14 years, are described. A coherent attitude of surveillance and interpretation of results, is proposed: principles enabling the origin and significance of the uranium found in a biological sampling to be assessed; mathematical formula to reply to the first questions that may be put when faced with contamination due to uranium; maximum allowable values for urinary excretion or faecal elimination for each type of internal contamination and according to the different forms of uranium compounds absorbed. The main results of surveillance and the different radiotoxicological controls obtained over more than 10 years practice in the Pierrelatte industrial complex are presented: systematic surveillance of chronic contamination; accidental contamination epi-

sode by inhalation of UF 6 having concerned more than 100 people. In an industrial complex such as that at Pierrelatte, and soon at Tricastin, this radiotoxicological surveillance is one of the most fundamental elements useful in prevention.

ANIMALS

REFER ALSO TO CITATION(S) 33933, 33975

33968 (UCD—472-124, pp 144-153) **Cumulative causes of death in radionuclide-treated beagles.** Chrisp, C.E.; Spangler, W.; Pool, R.R.; Goldman, M.; Rosenblatt, L.S. Oct 1977.

In Annual report, fiscal year 1977.

Deaths of 17 beagles treated with ^{226}Ra were attributed to osteosarcomas, melanomas, adenocarcinomas, and mammary carcinomas. Deaths of 36 beagles treated with ^{90}Sr were attributed to squamous cell carcinomas, fibrosarcomas, spinal meningiomas, and nasal carcinomas. Malignant lymphomas and mammary carcinomas were the most common causes of death from neoplasia. Other causes of death included congestive heart failure, diabetes insipidus, and thyroid atrophy. (HLW)

33969 (UCD—472-124, pp 182-184) **Survey of blood pressure in ^{226}Ra- and ^{90}Sr-treated beagles.** Spangler, W.L.; Dodds, S. Oct 1977.

In Annual report, fiscal year 1977.

Multiple blood pressure measurements on a total of 407 beagles with a non-invasive method showed the greatest frequency of mean pressures to be in the normal 101-120 mm Hg range. Another major group of dogs were hypertensive, with mean pressures of 120-140 mm Hg. Future correlation of canine blood pressures with diseases should prove useful in both veterinary and human medical research.

33970 **Condition of rat small intestine after exposure to iodine-131, strontium-89 and promethium-147 delivered separately and in combination.** Boitsova, V.P.; Vedernikov, V.P. *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 77-82(1977).

Translated from Radiobiologyiya; 17: No. 4, 530-535(1977).

A study was made of the effects of radionuclides varying in tropism on the structure of the rat small intestine. Administration of ^{131}I (16 days), and ^{89}Sr (60 days) in doses of 0.05, 0.5, 5.0 and 50.0 μCi/day, and ^{147}Pm (7 days) in doses of 0.5, 5.0, 50.0 and 500.0 μCi/day, separately and in combination by mouth, it was demonstrated that the small intestine of rats is a resistant system.

NUCLIDE KINETICS AND TOXICOLOGY

MAN

REFER ALSO TO CITATION(S) 33723, 33967, 33973

33971 (COO—1231-116) **Metabolism of ^{90}Sr and other elements in man, April 1, 1976—March 31, 1977 (extended without additional funding to March 31, 1978) and renewal proposal, April 1, 1978—March 31, 1979.** Spencer, H. (Loyola Univ., Maywood, Ill. (USA). Stritch School of Medicine). 1977. Contract EY-76-S-02-1231. 120p. Dep. NTIS, PC A06/MF A01.

Trace element studies of cadmium, copper, zinc, lead, manganese, and nickel were carried out under strictly controlled dietary conditions in adult males during different calcium intakes. Complete metabolic balances of the trace elements listed above were determined in each 6-day metabolic period for several weeks by analyzing the constant diet and the urinary and fecal excretions of these naturally occurring elements, using atomic absorption spectroscopy. Strontium-90 metabolism studies in man were carried out in order to complete previously initiated investigations. Publications and presentations of papers derived from studies carried out during the current contract period are listed.

ANIMALS

33972 (ORO—4056-7) **Intracellular transport of ions in mineralizing tissues.** Matthews, J.L. (Baylor Univ., Dallas, Tex. (USA). Medical Center). [nd]. Contract EY-76-S-05-4056. 10p. Dep. NTIS, PC A02/MF A01.

This study resulted in the development of a new model for bone cell physiology and has provided the means for studying the mechanism and site of action of bone affecting hormones and vitamin metabolites and has provided new information on mechanisms of mineralization and mineralization defects.

33973 (UCD—472-124, pp 157-160) **Effects of age and dosage-level on radium clearance kinetics in beagles.** Parks, N.J.; Pool, R.R.; Williams, J.R.; Wolf, H.G. Oct 1977.

In Annual report, fiscal year 1977.

Evaluations were made of individual, life-span ^{226}Ra-retention measurements of beagles receiving multiple injections at ages from juvenile to young adult. Equations are presented to describe the dependence of radium retention on exposure age in beagles and humans. Graphs are presented to show retention curves and effects of age and dose levels on fractional elimination rates. The model for age-dependent ^{226}Ra retention in humans predicts about 2.5 times greater retention for an exposure age of 17 yrs as compared to 28 yrs or later. The results of studies with beagles show that a factor of 3 difference in radiation dose can significantly alter the latent period and frequency of incidence of a given effect. (HLW)

33974 (UCD—472-124, pp 161-162) **Variation of radon retention parameters for radium-burdened dog skeletons as a function of exposure age and dosage level.** Parks, N.J.; Pool, R.R.; Williams, J.R. Oct 1977.

In Annual report, fiscal year 1977.

The effect of exposure age and dosage level on radon retention by ^{226}Ra-treated dogs was examined. Radon retentions for 36 beagles administered various levels of ^{226}Ra in eight semi-monthly injections at age 60 to 160, 120 to 220, or 435 to 535 days have been fitted by regression analysis to a power function of the form At/sup b/ (t = time after injection midpoint). Approximately 400 individual radon retention values were obtained from gamma-ray spectra taken at intervals over the lifespan of the animals. The mean parameter values for animals receiving total dosages <1.12 μCi/kg body weight at a midpoint age of 485 days were [7.99 (0.31 SE); 0.153 (0.005 SE)]. The differences in retention function parameters between the higher and lower ^{226}Ra dosage levels are interpreted in terms of radiation damage to bone, which alters the rate of mineralization in regions of radium deposition.

33975 (UCD—472-124, pp 167-168) **Age-related changes in the metabolism and effects of ^{131}I in guinea pigs.** Book, S.A.; McNeill, D.A. Oct 1977.

In Annual report, fiscal year 1977.

The metabolism and effects of ^{131}I in the thyroid gland have been investigated in fetal, neonatal and weanling guinea pigs. Neonates received the highest thyroidal dose per unit ^{131}I administered. Weanlings demonstrated a greater decrease in thyroid size per rad than other age groups.

33976 (UCD—472-124, pp 169) **Comparative effectiveness of ^{131}I and ^{132}I in the rat.** Book, S.A.; McNeill, D.A. Oct 1977.

In Annual report, fiscal year 1977.

Thyroids of rats injected with ^{131}I took up about 10% of the injected dosage, while those injected with ^{132}I showed an uptake of 2.5%. Peak uptakes occurred at 16 hours post-injection for ^{131}I and about 2 hours for ^{132}I. Iodine-131 left the thyroid with an effective half life (T/sub E/ of about 2 days. Based upon the retention time of ^{131}I, a T/sub E/ of 2 hours was calculated for ^{132}I. From these values and using a thyroid weight of 14 mg, doses of about 300 rads/μCi ^{131}I and 9 rads/μCi ^{132}I can be calculated. The effectiveness of ^{132}I is being compared with that of ^{131}I. Dosages of 0.33, 1, 3, 9, or 27 μCi ^{132}I or ^{131}I have been given to several animals to date, with additional dosages of 81 μCi ^{131}I already given, and equal or greater dosages of ^{132}I to follow. From limited preliminary data, a comparison of the inhibition of thyroid weight gain by the two radioiodines suggests a greater effect per unit dose for ^{132}I over that for ^{131}I, by about an order of magnitude.

33977 **Zirconium hexacyanoferrate in therapy of internal strontium-85 and cesium-134 contamination.** Severa, J. (J.E. Purkinje Inst., Hradec Kralove, Czech.). *Radiobiology (USSR) (Engl. Transl.);* **17**: No. 4, 200-202(1977).

Translated from Radiobiologiya; 17: No. 4, 629-631(1977).

Rats were given solutions of ^{85}Sr and ^{134}Cs by mouth and zirconium hexacyanoferrate (ZHC) was given by mouth at intervals following intake of radionuclides. Graphs are presented to show content of ^{134}Cs and ^{85}Sr as a function of time after intake of ZHC. When ZHC was given within 5 min of administration of ^{85}Sr or ^{134}Cs there was a significant decrease in absorption of the radioisotopes. It is believed that the effect of ZHC on intestinal absorption is due to ion exchange. (HLW)

THERMAL EFFECTS

MICROORGANISMS

REFER ALSO TO CITATION(S) 33853

PLANTS

33978 **Effect of temperature on the growth rate of Griffithsia tenuis c. agardh (Rhodophyta: ceramiales).** Reynolds, W.W.; Casterlin, M.E. (Pennsylvania State Univ., Wiles-Barre). *Hydrobiologia ;* **56**: No. 3, 225-227(1977).

Clonal cultures of Griffithsia tenuis were grown for 18 days (Erdschreiber solution, LD 12 : 12, 2200 lux) at 13, 18, 22 and 25°C.

The optimum temperature for growth (increase in number of cells) under these conditions was 22°C.

INVERTEBRATES

33979 Effect of temperature and age structure on p/b for Bosmina longirostris in a small impoundment. Janicki, A.J.; DeCosta, J. (West Virginia Univ., Morgantown). *Hydrobiologia ;* **56**: No. 1, 11-16(29 Sep 1977).

The relationships between temperature, the age structure, and daily P/B ratios for B. longirostris are examined. Temperature is the single most important factor affecting the daily P/B, while also having an indirect influence on the age structure. The rate of change of the daily P/B with temperature is nearly identical to the rate predicted by the "normal" Krogh curve.

33980 Adjustment of the components of energy balance in response to temperature change in Ostrea edulis. Newell, R.C.; Johson, L.G.; Kofoed, L.H. *Oecologia (Berlin);* **30**: No. 2, 97-110(1977).

Routine oxygen consumption (V_{02} µl 285 mg^{-1} h^{-1}) by specimens of Ostrea acclimated to temperatures between 5° and 25°C increases with exposure temperature throughout much of the range 5 to 30°C. There is little evidence of a relative suppression of the acutely-measured rate: temperature curves for routine oxygen consumption following warm acclimation. Energetic costs in Ostrea thus rise sharply with increase of environmental temperature. The clearance rate (V/sub w/, ml 285 mg^{-1} h^{-1}) of Phaeodactylum measured synchronously shows a marked thermal optimum within the range 15 to 28°C, followed by a decline towards high exposure temperatures. Maximal clearance rates of 600 to 750 ml water h^{-1} occur approximately 5°C above the temperature to which the animals have been acclimated and are adjusted according to environmental temperature. The changes in filtration efficiency)V/sub w// V_{02}, ml/µl) in Ostrea following thermal acclimation are controlled by compensatory responses of the irrigation rate rather than by a relative reduction of energy losses from metabolism. Because the clearance rate declines in animals acclimated to 25°C, whereas the metabolic losses increase throughout the temperature range 5 to 30°C, maximum filtration efficiency is achieved at 20°C. Calculation of the energetic cost of filtration suggests that the improvement of filtration following warm acclimation offsets metabolic energy losses even at low food concentrations in Ostrea. Even if energy losses not accounted for in the study were substantial, a positive index of energy balance could be maintained during the summer months at ration levels which commonly occur in inshore waters.

VERTEBRATES

33981 Relation between temperature and incubation time for eggs of chinook salmon (Oncorhynchus tshawytscha). Alderdice, D.F.; Velsen, F.P.J. (Pacific Biological Station, Nanaimo, Eng.). *J. Fish. Res. Board Can.;* **35**: No. 1, 69-75(Jan 1978).

With data assembled from the literature, relations are examined between incubation temperature and rate of development from fertilization to hatching for chinook salmon (Oncorhynchus tshawytscha) eggs. Ten forms of three empirical relations are used, based on the thermal sums hypothesis, Belehradek's equation, and a form of the logistic curve. In each case comparisons are made using constant, ambient, and combined (constant + ambient) incubation temperatures. In most cases the rules of minimum variance curve fitting are somewhat violated, although results using the log-inverse form of Belehradek's equation are superior to those from the other models. Early imposition of low, constant incubation temperatures (below 6 to 7°C) appears to slow egg development below those rates occurring at ambient temperatures having the same mean values. Time-temperature relations based on the unmodified thermal sums hypothesis and its associated "degree-days" are compared with predicted values obtained using the log-inverse Belehradek model as a standard. The former model tends to underestimate the length of the incubation period by an average of about 5 days at incubation temperatures above 4°C; below 4°C the former model increasingly overestimates the incubation period. Based on the log-inverse Belehradek model, a table is provided of predicted daily rates of development in relation to temperature. The table may be used to predict hatching time in a manner similar to that employing degree-days. In general, the enquiry points to a lack of data on development time at temperatures below 5°C; to be meaningful, further analyses will require such data.

33982 Relation of water temperature to infections of coho salmon (Oncorhynchus kisutch), chinook salmon (O. tshawytscha), and steelhead trout (Salmo gairdneri) with Aeromonas salmonicida and A. hydrophila. Groberg, W.J. Jr.; McCoy, R.H.; Pilcher, K.S.; Fryer, J.L. (Oregon State Univ., Corvallis). *J. Fish. Res. Board Can.;* **35**: No. 1, 1-7(Jan 1978).

Juvenile steelhead trout (Salmo gairdneri), coho salmon (Oncorhynchus kisutch), and spring chinook salmon (O. tshawytscha) were infected by intraperitoneal or intramuscular injection with Aeromonas salmonicida or A. hydrophila at seven temperatures from 3.9 to 20.5°C. At 3.9 and 6.7°C, mortality in fish infected with A. salmonicida varied from 2 to 26% among the three salmonid species. At 20.5°C 93 to 100% of these animals died within 2 or 3 days; at 6.7°C or lower the fish survived for 12 to 23 days. Growth of A. salmonicida in vitro was influenced by temperature in a manner very similar to its influence on the in vivo infection. Comparable experiments with A. hydrophila gave results much like those with A. salmonicida, though some differences were noted. At a temperature of 20.5°C percent mortality ranged from 64 to 100%. At 9.4°C or below no deaths attributed to A. hydrophila occurred. Fatally infected fish died more rapidly at the higher temperatures.

33983 Relation of water temperature to bacterial kidney disease in coho salmon (Oncorhynchus kisutch), sockeye salmon (O. nerka), and steelhead trout (Salmo gairdneri). Sanders, J.E.; Pilcher, K.S.; Fryer, J.L. (Oregon State Univ., Corvallis). *J. Fish. Res. Board Can.;* **35**: No. 1, 8-11(Jan 1978).

Juvenile coho salmon (Oncorhynchus kisutch), sockeye salmon (O. nerka), and steelhead trout (Salmo gairdneri) were infected by intraperitoneal injection of a suspension of the causative organism of bacterial kidney disease at seven experimental temperatures from 3.9 to 20.5°C. In coho salmon and steelhead trout percent mortality was maximal (78 to 100%) in the range of 6.7 to 12.2°C. As the temperature increased above 12.2°C mortality declined progressively; at 20.5°C it was only 8 to 14%. The two highest temperatures had some suppressing effect on the disease, which was greatest at 20.5°C. In sockeye salmon this was not apparent, as percent mortality was essentially 100% at all temperatures from 6.7 to 20.5°C; this species appeared to be highly susceptible to the disease agent. Temperature also influenced the mean number of days between infection and death. This interval was shortest in all three species of salmonids at the higher temperatures, varying from 21 to 34 days at 15.0 to 20.5°C. It increased progressively as temperature decreased below this range; at 6.7°C it varied from 60 to 71 days among the three species.

33984 Enzyme activities in the serum of rainbow trout, Salmo gairdneri Richardson; the effects of water temperature. Sauer, D.M.; Haider, G. (Univ., Stuttgart). *J. Fish Biol.;* **11**: No. 6, 605-612(Dec 1977).

Activities of lactate dehydrogenase, hydroxy butyric dehydrogenase, glutamic oxalacetic transaminase, glutamic pyruvic transaminase, glutamate dehydrogenase, creatinine kinase, alkaline phosphatase, and leucine amino peptidase were determined in the sera of rainbow trout. The animals had previously been adapted to temperatures of 3.5, 6, 8, 10, 12.5, 15, 17, 19, 21.5 and 23°C. Most of the enzyme activity increased with the rise in temperature. The activity of alkaline phosphatase decreased in the range 6 to 19°C, while the changes in the glutamate dehydrogenase activity took a complex course. The results are compared with the findings of other authors.

33985 Effect of temperature on routine metabolism in Tilapia rendalli boulenger. Caulton, M.S. (Univ. of Rhodesia, Salisbury, South Africa). *J. Fish Biol.;* **11**: No. 6, 549-553(Dec 1977).

Using a continuous flow respirometer it was shown that young Tilapia rendalli had three distinct phases of oxygen consumption over the temperature range of 17 to 40°C. In the first phase (17 to 28°C) the metabolic energy demand followed the normal logarithmic increase with increasing temperature. Between 28 and 37°C the increased oxygen uptake was suppressed and showed a relatively small increase with increasing temperature. This feature was believed to be a significant energy saving function important to the growth of these fish which feed in the warm eulitoral margins of lakes during the day. The final phase shows a return to the original logarithmic increase in oxygen consumption. These results were related to, and compared with, actual changes in biomass at various temperatures and the theoretical and actual biomass changes were found to compare favorably.

33986 Effects of temperature and ration level on the growth and food conversion efficiency of Salmo gairdneri, Richardson. Wurtsbaugh, W.A.; Davis, G.E. (Oregon State Univ., Corvallis). *J. Fish Biol.;* **11**: No. 2, 87-98(Aug 1977).

The effects of temperature and ration size on the growth rate and gross efficiency of food conversion of juvenile rainbow trout Salmo gairdneri were evaluated during 25-day seasonal experiments. Rations ranged from near-starvation to repletion levels. Test temperatures were 3 and 6°C higher than the controls which fluctuated dielly and seasonally. At rations near maintenance, elevated temperatures decreased trout growth. As the feeding rate increased the detrimental effect of temperature on growth was ameliorated. At repletion feeding levels, elevated temperature up to 17°C improved trout growth by increasing the maximum food consumption rate. With a temperature increase from 6.9 to 22.5°C maintenance rations increased from 2.2 to 7.5% body weight per day. Gross efficiency was dependent upon ration level and temperature. As the food consumption rate increased, efficiency increased to a maximum, then generally declined at repletion levels. Elevated temperatures resulted

in reduced efficiencies at low consumption rates but temperatures had little effect at high ration levels. A field study provided estimates of the food consumption relationships established in the laboratory, suggested any substantial increase of stream temperature without a concomitant increase of food abundance would result in decreased trout production.

CHEMICALS METABOLISM AND TOXICITY

REFER ALSO TO CITATION(S) 32977, 34027

33987 **Conversion's the name of the game.** *Environ. Sci. Technol.;* 11: No. 12, 1048-1051(Nov 1977).

The 12th Intersociety Energy Conversion Engineering Conference was held in late August 1977 in Washington, D.C. Discussed was the Riverside Boiler. This boiler opens up possibilities for burning coal without the need for SO/sub x/ scrubbers. The system removes up to 95% of SO_2 emissions from coal. Preliminary designs are being made for a 200-MW FBC-based central generating station. Also discussed was solar energy and its impact assessment. A forum of current information on environmental toxicology was held at the 174th National Meeting of the American Chemical Society. The papers given focused on: a new use for the old Ames test; a description of a lung-organ culture system that can be used as a first-order screening system; a comparison of the respiratory physiology, lung structure and reactions to pollutants in man, other primates, rodents and dogs; an argument for chronic, low-level exposure studies to acquire reliable health-effects data needed for setting standards; and a description of a sensitive whole-animal model system for assessing the combined effects of air pollutants and infectious agents on pulmonary defense mechanisms.

CELLS

REFER ALSO TO CITATION(S) 33487, 33699

33988 (CONF-760927—, pp 58-65) **Cytotoxicity to alveolar macrophages of metal oxides adsorbed on fly ash.** Aranyi, C. (IIT Research Inst., Chicago); Andres, S.; Ehrlich, R.; Fenters, J.D.; Gardner, D.E.; Waters, M.D. 1977.

From 16. annual Hanford biology symposium on pulmonary macrophage and epithelial cells; Richland, WA, USA (27 Sep 1976).

In Pulmonary macrophage and epithelial cells.

Fly-ash particles fractionated into three size ranges (<2, 2 to 5, and 5 to 8 μm) and coated with various metal oxides were used to determine whether particle size and surface area are contributing factors to the in vitro toxicity of trace metals for alveolar macrophages (AM). When uncoated fly-ash particles and those coated with PbO, NiO, and MnO_2 in concentrations ranging from 50 to 1500 μg particles/ml were incubated with 10^6 AM/ml, reduced viability was observed on increase in concentration irrespective of type or size range of the particles. Within a given particle type and exposure concentration, decrease in particle size resulted in decreased viability and increased phagocytosis. The toxic effect was not due to the solubilization of the test elements into the incubating medium. The percentage of lead, nickel, or manganese adsorbed on the fly-ash particles varied within a relatively narrow range and was not affected by the particle size. Since the AM were exposed to the particles on a weight—dose per cell basis, their effective exposure load to the test elements was constant irrespective of the particle size. Thus the greater toxicity of the small particles appears to be due to surface interaction between particles and AM, and toxic effect is surface-area as well as dose related. These observations are further supported by decreases measured in total cellular protein levels and specific activity of lactate dehydrogenase.

33989 (UCD—472-124, pp 44-46) **Electron microscopic studies of pulmonary alveolar macrophages and fly ash.** Fisher, G.L.; Hayes, T.L.; McNeill, K.L.; Pawley, J.B. Oct 1977.

In Annual report, fiscal year 1977.

The phagocytic activity of pulmonary alveolar macrophages exposed to fly ash, silica, and glass beads was studied with a scanning electron microscope. Whereas fly ash particles and glass beads were found both inside the cells and on cell surfaces, silica was observed only on the surface. X-ray elemental mapping disclosed individual fly ash particles within macrophages rich in Ca and Fe as well as a more homogeneous distribution of Ti.

33990 (UCD—472-124, pp 47-49) **Growth of canine alveolar macrophage colonies.** Whaley, C.; Wilson, F.D.; Fisher, G.L.; Shifrine, M.; McNeill, K. Oct 1977.

In Annual report, fiscal year 1977.

Colonies of canine alveolar macrophages were grown in methyl cellulose culture. The addition of an appropriate colony stimulating factor, normal horse serum, was necessary for colony growth. The technique was applied for quantitating the effects of potential pulmonary toxicants. Treatment with fly ash, silica and inert glass beads in vitro inhibited macrophage colony formation.

33991 (UCD—472-124, pp 50-57) **Functional studies of lavaged pulmonary alveolar macrophages exposed to particles in vitro.** Fisher, G.L.; McNeill, K.L.; Whaley, C.B.; Fong, J. Oct 1977.

In Annual report, fiscal year 1977.

Pulmonary alveolar macrophages (PAM) lavaged from mice and rates were exposed in vitro to various particles, and adherence, viability, and phagocytosis were assessed with a new technique. Phagocytosis of carbonized polystyrene latex microspheres increased most rapidly within the first 4 hours of incubation. Enhanced phagocytosis was noted after incubation with media alone or with silica or glass beads, but fly ash delayed this phagocytosis increase. Factors that depressed PAM adherence (KCN and V_2O_5 in HCl) also decreased viability. PAM lavaged from animals sacrificed with lethal dosages of anesthetics were compared to those sacrificed by cervical fracture. Decreased viability, adherence and phagocytosis characterized PAM from the animals receiving anesthesia.

33992 (UCD—472-124, pp 58-60) **Alveolar macrophage migration: chemotaxis and random mobility under agarose.** Schwartz, L.W.; Christman, C.A.; Hood, V.L. Oct 1977.

In Annual report, fiscal year 1977.

Macrophages were obtained from lungs of rats breathing filtered air and those of rats breathing filtered air containing ozone, and the cells were exposed to agarose. Evaluation of migration was performed as follows: with an ocular micrometer measuring the farthest distance cells had migrated from the edge of the well and by counting the number of cells exterior to the well at four separate points with a 400-point grid ocular. The increased number of cells retrieved after ozone exposure correlated with morphological indicators of damage. The viability of cells retrieved was very good and was independent of ozone exposure. Ozone did not affect the number of cells migrating randomly or the distance. (HLW)

33993 (UCD—472-124, pp 63-71) **Effects of acute inhalation of fly ash and silica: a preliminary report.** Fisher, G.L.; Wilson, F.D.; Boorman, G.A. Oct 1977.

In Annual report, fiscal year 1977.

The potential biological effects of inhaled coal fly ash and silica were assessed utilizing a variety of macrophage functional assays and clonogenic techniques. C57BL/6 mice were exposed acutely in a small rodent inhalation chamber at aerosol concentrations of 20 or 200 μg/l. Mice were sacrificed 2, 6, and 15 days after exposure. In vitro cloning techniques were used to evaluate response in the bone marrow, spleen, and pulmonary alveolar macrophages (PAM). Lung pathology, bacterial clearance, and in vitro function of PAM, which included viability, adherence and phagocytosis were also evaluated. Acute inhalation of low levels (approximately 30 μg/l) of silica or fly ash did not affect macrophage function although splenic CFU-C and PAM colonies were affected.

MICROORGANISMS

REFER ALSO TO CITATION(S) 33746, 33757, 33848

33994 (UCD—472-124, pp 41-43) **Mutagenicity of filtrates from respirable coal fly ash.** Chrisp, C.E.; Fisher, G.L.; Lammert, J.E. Oct 1977.

In Annual report, fiscal year 1977.

Incubation of histidine requiring auxotrophs of the bacterium Salmonella typhimurium with cyclohexane, saline and serum-soluble components of respirable fly ash particles produced an increased number of revertants in two frameshift tester strains. The results of these experiments are consistent with the hypothesis that both organic and inorganic mutagens are present in coal fly ash.

PLANTS

REFER ALSO TO CITATION(S) 33685, 33907

33995 (BNL—23302) **Effects of solutions to simulate acidic precipitation on fertilization of the Bracken fern (Pteridium aquilinum).** Evans, L.S.; Bozzone, D.M. (Manhattan Coll., New York (USA). Lab. for Plant Morphogenesis; Brookhaven National Lab., Upton, N.Y. (USA)). 1977. Contract EY-76-C-02-0016. 20p. (CONF-770852—3). Dep. NTIS, PC A02/MF A01.

From National environmental research park symposium) natural resource inventory, characterization, and analysis; Los Alamos, NM, USA (15 Aug 1977).

Experiments were performed to determine the effects of chloride, nitrate, and sulfate in buffered solutions on sperm motility and fertilization in gametophytes of Pteridium aquilinum. Buffered solutions with various anions simulated exposures to acidic precipitation up to 3.5 hr. The presence of each anion decreased both sperm motility and fertilization.

33996 Assessment of the use of forests as sinks for the removal of atmospheric sulfur dioxide. Murphy, C.E. Jr. (E.I. du Pont de Nemours and Co., Aiken, SC); Sinclair, T.R.; Knowerr, K.R. *J. Environ. Qual.;* **6**: No. 4, 388-396(1977).

A computer model was developed for estimating the uptake of sulfur dioxide (SO_2) by forests. Submodels are used to calculate atmospheric diffusion immediately above and within the forest canopy, and into the sink areas within the trees. The program implementing the model is general and can be used with only minor changes for many gaseous pollutants. Simulations with SO_2 sources above the canopy indicate that moderate amounts of SO_2 can be absorbed by forests during periods of favorable weather. Simulations with sources inside the canopy suggest that SO_2 uptake can be increased while tolerable levels of SO_2 concentrations are maintained in the atmosphere within the forest.

33997 Growth of loblolly pine seedlings in strip-mined Kaolin spoil as influenced by sewage sludge. Berry, C.R.; Marx, D.H. *J. Environ. Qual.;* **6**: No. 4, 379-381(1977).

Loblolly pine seedlings (Pinus taeda L.) were transplanted and grown outdoors for 6 months in microplots containing strip-mined kaolin spoil amended with different quantities of dry sewage sludge. Seedlings on kaolin spoil amended with sludge equivalent to 34 metric tons/ha had greater height, stem diameter, and fresh weight (49, 79, and 126 percent increases, respectively) than seedlings on non-amended spoil. The percent of short-roots with ectomycorrhizae was higher on seedlings grown in spoil with 34 and 69 metric tons/ha sludge than in spoil with 0, 138, or 275 metric tons/ha sludge. At the end of the experiment, chemical analysis revealed significantly greater quantities of residual organic matter and essential elements for plant growth in kaolin spoil amended with sludge than in nonamended spoil. Sewage sludge is apparently an excellent organic amendment for kaolin spoil; even small amounts significantly stimulate growth and mycorrhizal development of loblolly pine seedlings.

33998 Disruption of nutrient pools and transport of heavy metals in a forested watershed near a lead smelter. Jackson, D.R. (Oak Ridge Associated Univ., TN); Watson, A.P. *J. Environ. Qual.;* **6**: No. 4, 331-338(1977).

A 1-year study was initiated in March 1974 to measure the distribution and investigate the effects of the heavy metals Pb, Cd, Zn, and Cu on a forested ecosystem (Crooked Creek Watershed) located near a Pb smelter in southeastern Missouri. Atmospheric discharges of heavy metal particulates have impacted the watershed since 1968. Recent annual deposition rates of particulate Pb, Cd, Zn, and Cu measured within 0.4 km from the smelter were 103, 0.72, 6.4, and 2.1 g/m^2, respectively. Sampling stations were established at 0.4-, 0.8-, 1.2-, and 2.0-km intervals along a centrally located transect on the watershed. The transect was located on the leeward side of the smelter stack and in line with the prevailing wind direction. Extremely high metal concentrations in soil and vegetation along the transfer reflected the long-term impact of emissions on the watershed. Two stages of ecosystem disruption on Crooked Creek Watershed were found: (i) an initial stage (1.2 to 2.0 km from the stack) characterized by an accumulation of O2 litter with no measurable effects on soil-litter biota, and (ii) an advanced stage (0.4 to 0.8 km from the stack) characterized by depletion of soil and litter nutrient pools with evidence of depressed decomposer communities and nutrient translocation. This study indicates that disruption of nutrient cycling mechanisms may serve as an early indicator of ecosystem stress in response to chemical contamination.

INVERTEBRATES

REFER ALSO TO CITATION(S) 34019

33999 Sublethal effects of heavy metal contaminated sediment on midge larvae (Chironomus tentans). Wentsel, R.; McIntosh, A.; Atchison, G. (Purdue Univ., West Lafayette, IN). *Hydrobiologia ;* **56**: No. 2, 153-156(27 Oct 1977).

Chironomid larvae were maintained for 17 days in sediments with various heavy metal levels. The control sediment had levels of 0.6 ppM cadmium, 17 ppM chromium and 77 ppM zinc. The most contaminated sediment had levels of 1030 ppM cadmium, 1640 ppM chromium, and 17300 ppM zinc. The mean length and weight of the larvae from the control sediment were 1.83 cm and 2.86 mg. The mean length and weight of larvae from the most contaminated sediment were 0.82 cm and 0.20 mg. A linear relationship was found for the square root of length versus metal levels in the sediment.

34000 Potentiation of zinc stress caused by parastic infection of snails. Guth, D.J. (Univ. of Michigan, Flint); Blankespoor, H.D.; Cairns, J. Jr. *Hydrobiologia ;* **55**: No. 3, 225-229(8 Sep 1977).

The purpose of this experiment was to determine the effects of parasitism (Schistosomatium douthitti Price and Trichobilharzia sp.) on the tolerance of snails Lymnaea stagnalis (L.) to acutely lethal concentrations of zinc. Significant reduction in tolerance occurred for snails with patent infections at 24 and 75 ppM of Zn^{++}. At two selected prepatent levels of parasite development, significant differences occurred at the higher concentration only.

34001 Effects of free chlorine and chloramine on growth and respiration rates of larval lobsters (Homarus americanus). Capuzzo, J.M. (Woods Hole Oceanographic Institution, MA). *Water Res.;* **11**: No. 12, 1021-1024(1977).

The length, dry weight and standard respiration rate of larval lobsters (Homarus americanus) were monitored for 19 days following a 60 min exposure at 25°C to 1.0 mg l^{-1} applied free chlorine and 1.0 mg l^{-1} applied chloramine. Compared to control organisms, significantly lower increases in dry weight (P less than 0.05) and significant reductions in standard respiration rates (P less than 0.01) were measured among exposed organisms; greater differences were detected among chloramine exposed organisms. From these results it can be concluded that acute exposure to either free chlorine or chloramine results in subsequent reductions in growth and metabolic activity of larval lobsters.

VERTEBRATES

REFER ALSO TO CITATION(S) 33694, 33745, 33779

34002 (ORNL—5375) **Epidermal carcinogenicity of bis[2,3-epoxycyclopentyl]ether, 2,2-bis(p-glycidyloxyphenyl)propane, and m-phenylenediamine in C3H and C57BL/6 inbred male and female mice.** Holland, J.M.; Gosslee, D.G.; Gipson, L.C.; Whitaker, M.J. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 76p. Dep. NTIS, PC A05/MF A01.

Application of bis[2,3-epoxycyclopentyl]ether(I), 2,2-bis(p-glycidyloxyphenyl)propane (II), or a 1:1 mixture of I and II three times weekly for 24 months induced malignant epidermal tumors in C3H and C57BL/6 mice. C57BL/6 mice were more sensitive to skin carcinogenesis as evidenced by a higher frequency of mice responding at the highest doses were, for C3H: compound I, 5/80 (6 percent); II, 0/80; I + II, 51/80 (64 percent); and for C57BL/6: compound I, 5/39 (13 percent); II, 8/40 (20 percent); I + II, 32/40 (80 percent). The substantial difference in the potency of the materials applied as a 1:1 mixture as opposed to their effects when tested individually suggested synergistic interaction. Similar tests of the skin carcinogenicity of m-phenylenediamine were negative at all doses and in both strains. An increased incidence of lung tumors (p less than 0.004) relative to vehicle control was detected in C3H mice treated at the highest dose of I.

34003 (UCD—472-124, pp 72-74) **Morphological evaluation of pulmonary changes induced by power plant fly ash.** Schwartz, L.W.; Brummer, M.E.; Hood, V.L. Oct 1977.

In Annual report, fiscal year 1977.

Rats were continuously exposed for 90 days to fly ash and were divided into two groups. One group was killed immediately and the second group was exposed to ambient room air for an additional 90 days. Thoracic tissues were examined by light microscopy and scanning electron microscopy. Grossly, the lungs and lymph nodes were gray-black. Microscopic changes were chiefly within alveoli and consisted of accumulations of macrophages heavily laden with granular debris. The recovery period of 90 days resulted in only minor morphological differences from those examined immediately. Results indicated that large quantities of fly ash induce pulmonary changes confined to alveolar regions and consist of accumulations of phagocytic inflammatory cells. (HLW)

34004 (UCD—472-124, pp 75-76) **Biochemical evaluations of acute, short-term fly ash exposure in rats.** Last, J.A. Oct 1977.

In Annual report, fiscal year 1977.

Groups of rats were exposed for 3 days to ball-milled fly ash or to aerodynamically sized fly ash for 7 days. Lung tissues were homogenized and DNA, RNA, and protein values were determined. The tabulated results suggested that there was a difference between types of fly ash, between exposure doses, or a difference between 3 and 7 days of exposure. The experiments were designed to test methodology for use with chronic, long-term exposure to fly ash. (HLW)

34005 (UCD—472-124, pp 77-82) **Deposition and early distribution of inhaled soluble pollutant aerosols in Rhesus monkeys.** Parks, N.J.; Raabe, O.G.; Bradley, E.W.; Teague, S.; Hopkins, B. Oct 1977.

In Annual report, fiscal year 1977.

Rhesus monkeys were exposed to a "model" hygroscopic aerosol, $(NH_4)_2SO_4$, labeled with radioactive nitrogen-13. Particles with initial sizes in the range 0.8 to 0.9 μm (AMAD) appeared to deposit primarily in the upper trachea and larynx. Particles about 0.5 μm AMAD were deposited more uniformly in the trachea and bronchial regions. The kinetic data for tracer transfer to the circulatory system are described.

34006 Toxicity of cadmium to goldfish, Carassius auratus, in hard, and soft water. McCarty, L.S.; Henry, J.A.C.; Houston, A.H.

(Brock Univ., St. Catharines, Ontario). *Biol. Conserv.;* **35**: No. 1, 35-42(Jan 1978).

Variations in cadmium form and concentration and in selected water quality parameters (pH, dissolved oxygen, total hardness, total alkalinity, conductivity) were monitored during static bioassays conducted with relatively soft (approximately 20 mg/L as $CaCO_3$) and hard (approximately 140 mg/L as $CaCO_3$) waters. Cadmium concentrations were reasonably stable in soft water, and with the exception of total hardness, water quality was not greatly altered during assay. Cumulative mortality curves were of a simple sigmoidal type and readily analyzed by conventional procedures. LC50 values of 2.76, 2.13, and 1.78 mg Cd/L were estimated on the basis of 48-, 96-, and 240-h periods of observation. During hard-water trials there were transient increases in the amount of particulate cadmium present and sharp decreases in total cadmium levels. Several parameters (pH, total alkalinity, conductivity) exhibited transient and/or sustained variations of a cadmium concentration-dependent type. Mortality curves were typically biphasic. The extent of first-phase mortality was significantly correlated with the magnitude of the initial pH decline and the amount of cadmium present in centrifugable form. Conventional procedures did not result in rectification of 240-h cumulative mortality curves, and the 240-h LC50 value (40.2 mg Cd/L) is considered to be inherently less precise than those obtained on the basis of 48- and 96-h periods of observation (46.9, 46.8 mg Cd/L).

34007 Acute toxicity of inorganic chloramines to early life stages of brook trout (Salvelinus fontinalis). Larson, G.L.; Hutchins, F.E.; Schlesinger, D.A. (Oregon State Univ., Corvallis). *J. Fish Biol.;* **11**: No. 6, 595-598(Dec 1977).

The acute toxicity of inorganic chloramines to brook trout alevin, fry, and juvenile life stages was determined in 96-h tests. Toxicity was not constant between the life stages. Alevins were more tolerant than the fry group tested. Alevins showed a decreased tolerance with an increase of body weight. Two groups of juveniles were similar in tolerance to the heaviest alevin group. A relationship between life stage-body weight of brook trout and 96-h median tolerance limits is presented.

34008 Toxicity of cadmium to Schistosoma mansoni cercariae: effects on vitality and developmental ability in white mice. Holliman, R.B. (Virginia Polytechnic Inst. and State Univ., Blacksburg); Esham, L.P. *Hydrobiologia ;* **56**: No. 1, 81-88(29 Sep 1977).

Time-until-death studies were run on cercariae of Schistosoma mansoni in 8 concentrations of cadmium (from cadmium sulfate) ranging from 100 ppM to 0.0001 ppM. All concentrations used were found to be toxic, and at 10 ppM all cercariae were dead within 4 hours, which coincides with their period of maximum infectability following emergence from the snail host. At 2 ppM, all cercariae died within 8 hours, and at 1 ppM all died within 16 hours. In addition, groups of cercariae were exposed to cadmium concentrations of 10, 1, and 0.1 ppM for periods of 30, 20, and 10 minutes. Thereafter, cercariae from these groups were allowed to penetrate the tails of white mice or were injected subcutaneously into mice. After 8 weeks, these mice were autopsied and the adult worms collected by perfusion. Maturation of cercariae from both methods of invasion was seriously impaired. Statistical analysis using a 3 x 4 x 2 factoral design for analysis of variance showed both time of exposure and concentration of cadmium ion to be significant factors in determining number of worms developing at $p = 0.01$. A significant interaction between time of exposure and concentration was found to exist. The two methods of infection did not have a significant effect on the number of worms recovered. Therefore, it appears that those toxicant-exposed cercariae capable of maturing do not need assistance in transversing the skin barrier but can penetrate and migrate to reach the mesenteric venules for maturation.

34009 Toxicity of intermittent chlorination to fresh water fish: influence of temperature and chlorine form. Heath, A.G. (Virginia Polytechnic Inst. and State Univ., Blacksburg). *Hydrobiologia ;* **56**: No. 1, 39-47(29 Sep 1977).

Fingerling size Salmo gairdneri, Oncorhynchus kisutch, Notemigonus crysoleucas, Cyprinus carpio, and Ictalurus punctatus were exposed in the laboratory three times daily for up to seven days to pulses of either free chlorine or monochloramine. This regime simulated conditions often encountered in the outfall of steam electric generating plants which chlorinate intermittently. LC_{50}'s, and response isopleths giving various percentage mortalities, were computed from the bioassays. S. gairdneri, O. kisutch, and I. punctatus were the most sensitive to both types of chlorine. C. carpio were most resistant and the N. crysoleucas were intermediate in sensitivity. Temperature had relatively little effect on the toxicity of intermittent chlorine to the species tested. In this type of test regime, free chlorine was three to fourteen fold more toxic (depending on the species) than monochloramine. Water quality criteria for the protection of fish should, in the future, take this differential toxicity into consideration.

34010 Effects of cadmium on the activity of alkaline phosphatase in various tissues of Lepomis Gibbosus L. (Pisces; Centrarchidae). Piavaux, A. (EURATOM, Ispra, Italy). *Hydrobiologia ;* **55**: No. 3, 251-256(8 Sep 1977). (In French).

To study the effects of cadmium on the activity of Zn-metalloenzymes, fishes have been exposed to different concentrations of that metal. The concentrations of Zn and Cd and the activity of alkaline phosphatase were measured in some tissues. From the results it seems there is no competition between Zn and Cd for the enzymatic sites of the alkaline phosphatase.

34011 Studies on the toxicity of cadmium to the three-spined stickleback Gasterosteus aculeatus L. Pascoe, D.; Mattey, D.L. (Univ. of Wales, Cardiff). *J. Fish Biol.;* **11**: No. 2, 207-215(Aug 1977).

Cadmium was found to be lethal to sticklebacks at all concentrations from 100.0 to 0.001 mg Cd l^{-1}, in water of 103-111 mg l^{-1} hardness as $CaCO_3$. The pattern of mortality as shown by the time-concentration curve suggests that toxicity is not due to a single mechanism but changes with concentration. Fish were found to accumulate cadmium, the whole body levels incrasing from 0.90 μg/g fresh weight at 0.001 mg Cd l^{-1} exposure concentration to 51.0 $\mu g/g$ at 100 mg Cd l^{-1}. The concentration factor was shown to decrease with increasing exposure concentration from 0.51 at 100 mg Cd l^{-1} to 511 at 0.001 mg Cd l^{-1}. The plerocercoid parasite Schistocephalus solidus in the host's perivisceral cavity contained less cadmium than the tissues of its host.

34012 Organochlorine and mercury residues in canvasback duck eggs, 1972—1973. Stendell, R.C.; Cromartie, E.; Wiemeyer, S.N.; Longcore, J.R. (Patuxent Wildlife Research Center, Laurel, MD). *J. Wildl. Manage.;* **41**: No. 3, 453-457(Jul 1977).

Eggs of canvasback ducks (Aythya valisineria) from several major breeding areas were analyzed for organochlorine and mercury residues. Polychlorinated biphenyls (PCBs) were detected in 96 of 97 eggs, in concentrations up to 29 ppM (wet wt.). DDE occurred in 79% of the samples with a maximum residue of 12 ppM (wet wt.). DDT, DDD, dieldrin, hexachlorobenzene, cis-chlordane, heptachlor epoxide, and oxychlordane were detected less frequently. Mercury was detected in only 6 of 34 eggs analyzed. Most of the eggs contained concentrations of organochlorines and mercury below levels known to cause adverse effects on avian survival or reproduction.

34013 Effects of phenyl mercury on captive game farm pheasants. Mullins, W.H. (Univ. of Idaho, Moscow); Bizeau, E.G.; Benson, W.W. *J. Wildl. Manage.;* **41**: No. 2, 302-308(Apr 1977).

Effects of phenyl mercury acetate administered to captive game farm pheasant (Phasianus colchicus) hens in both capsule and feed form were investigated. Total mercury level in hens given 20 mg Hg/kg body weight in capsules rose sharply in kidney, liver, and ovarian follicle samples. Soon after administration, these levels decreased rapidly, approaching control levels 2 weeks after administration. Compared to control birds, hens treated with 20 mg Hg/kg body weight in capsules showed significant decreases in egg hatchability, eggshell thickness, chick weight, and chick survivability ($P < 0.05$) but there were no significant differences in egg production, egg volume, fertility, or chick behavior ($P > 0.05$). Hens fed wheat ad libitum which had been treated with phenyl mercury fungicide at the normal field rate showed highest total mercury levels in kidney tissues, lowest in muscle tissues. Compared to controls, this group had no significant differences in any of the parameters tested. We concluded that low amounts of phenyl mercury in the diet are not harmful to game farm pheasants.

34014 Effect of exposure time and copper concentration on reproduction of the fathead minnow (Pimephales promelas). Pickering, Q.; Brungs, W.; Gast, M. (Environmental Protection Agency, Cincinnati). *Water Res.;* **11**: No. 12, 1079-1083(1977).

Three concurrent studies were conducted to determine the chronic effect of prespawning exposure to various concentrations of copper on fathead minnow reproduction. Copper was introduced into the three exposure systems to give 6-, 3-, and 0-months exposure prior to spawning. Prespawning exposure time had no significant effect on reproduction. Number of eggs produced per female decreased, however, with increase in copper concentrations. Egg production at copper concentrations of 37 μg l^{-1} and higher was significantly lower ($P = 0.05$) than in the control, but at concentrations of 24 μg l^{-1} and lower it was not different. The maximum acceptable toxicant concentrations (MATC) was estimated to be 32 μg Cu l^{-1}, which is 0.07 of the 96 h LC_{50}. This application factor for copper is similar to those found in other studies.

34015 Effects of zinc on the cardiac and ventilatory rhythms of rainbow trout (Salmo gairdneri, Richardson) and their responses to environmental hypoxia. Hughes, G.M.; Adeney, R.J. (Univ. of Bristol, England). *Water Res.;* **11**: No. 12, 1069-1077(1977).

Recordings were made of the cardiac and ventilatory rhythms of rainbow trout subjected to solutions of 40 and 10 ppM zinc in an experimental circulation. The higher concentration pro-

duces clearly-defined increases in ventilatory and coughing frequency and a decrease in heart rate; the percentage coupling between the two rhythms usually increased. During exposure to 10 ppM added zinc the effects are not so readily discernible but are comparable in type. The addition of 10 ppM zinc has a significant effect on the responses of rainbow trout to hypoxia before and after this treatment. It is concluded that zinc interferes with some of the mechanisms involved in the uptake of oxygen at the gills and consequently can significantly affect the ability of fish to respond to the additional stress of oxygen lack in its environment.

34016 Fish toxicity of jet fuels. I. The toxicity of the synthetic fuel JP-9 and its components. Klein, S.A.; Cooper, R.C. (Univ. of California, Berkeley). *Water Res.;* **11**: No. 12, 1059-1067(1977).

The toxicity of the jet fuel JP-9 and its components RJ-4, RJ-5 and MCH was assessed in static bioassays on the warm water fish, golden shiner (Notemigonus chrysoleucas). The 96-h LC_{50} of emulsions was 2.0 mg l^{-1} for JP-9, 0.51 mg l^{-1} for RJ-4, 0.61 mg l^{-1} for RJ-5 and 72 mg l^{-1} for MCH. As determined by the 96-h LC_{50} values unemulsified fuel (pools of fuel) JP-9 was 235 times less toxic, RJ-4 was 196 times less toxic, RJ-5 was 7700 times less toxic and MCH was 3.3 times less toxic than the corresponding emulsified materials. In continuous flow bioassays with the water soluble fraction of the fuel and its components the effect on egg hatchability and fry development of flagfish (Jordanella floridae) and rainbow trout (Salmo gairdneri) was studied. The no effect of level on flagfish egg hatchability was 0.23 mg l^{-1} for JP-9 and 0.05 mg l^{-1} for RJ-5. Concentrations of 0.83 mg l^{-1} MCH and 0.2 mg l^{-1} RJ-4 did not affect egg hatchability. In rainbow trout studies 97-day LC_{50} values for RJ-4 and RJ-5 were 0.045 mg l^{-1} and 0.072 mg l^{-1}, respectively, and 23-day LC_{50} values for JP-9 and MCH were 0.26 mg l^{-1} and 1.3 mg l^{-1}, respectively. The accumulation of fuels in fish bodies was studied and it was found that flagfish can tolerate a total body burden of 0.5 mg MCH g^{-1} wet weight without lethality. It was also found that body burdens of 0.43 mg RJ-4 g^{-1} and of 0.27 mg RJ-5 g^{-1} on a wet weight basis will produce 50 percent mortality in rainbow trout. Voiding of MCH from fish bodies occurs readily in fuel-free water, but RJ-4 and RJ-5 are retained in the tissues.

34017 Toxicity of chlorine to juvenile spot, Leiostomus xanthurus. Middaugh, D.P.; Crane, A.M.; Couch, J.A. (Environmental Protection Agency, John's Island, SC). *Water Res.;* **11**: No. 12, 1089-1096(1977).

The sensitivity of juvenile spot, Leiostomus xanthurus, to total residual chlorine (TRC) in flowing sea-water was investigated. Incipient LC_{50} bioassays, histopathology, avoidance tests and the combined effect of thermal stress and TRC were used to assess sensitivity. Estimated incipient LC_{50} values were 0.12 mg l^{-1} TRC at 10°C and 0.06 mg l^{-1} TRC at 15°C. Histological examination of spot used in the incipient LC_{50} bioassay at 15°C and sacrificed while alive indicated pseudobranch and gill damage occurred in individuals exposed to a measured TRC concentration of 1.57 mg l^{-1}. Spot exposed to lower concentrations of TRC, 0.02 to 0.06 mg l^{-1} at 15°C and sacrificed alive showed no consistent tissue damage. Spot demonstrated temperature dependent avoidance responses to TRC. At 10°C a concentration of 0.18 mg l^{-1} was required for significant (X^2, P less than 0.05) avoidance; at 15 and 20°C, spot showed significant avoidance of TRC concentrations as low as 0.05 mg l^{-1}. Simultaneous exposure of spot to thermal stress (5, 10 or 13°C above the acclimation temperature of 15 C) at measured TRC concentrations of 0.05 to 0.07 and 0.34 to 0.52 mg l^{-1} demonstrated a significant, (X^2 with Yates correction, P less than 0.05) increase in sensitivity to TRC with increased temperature and exposure times for some of the groups tested.

34018 Comparative short-term tolerance of zebrafish, flagfish, and rainbow trout to five poisons including potential reference toxicants. Fogels, A.; Sprague, J.B. (Univ. of Guelph, Ont.). *Water Res.;* **11**: No. 9, 811-817(1977).

Zebrafish (Brachydanio rerio) and flagfish (Jordanella floridae) were evaluated as potential standard species for aquatic bioassays in Canada by comparing their short-term tolerance to that of rainbow trout (Salmo gairdneri). When threshold or 10-day LC_{50}'s for rainbow trout were assigned a value of 1.0, corresponding values for zebrafish and flagfish were respectively: copper sulfate, 1.6, 7.2; sodium pentachlorophenate, 4.7, 7.6; phenol, 2.5, 3.1; picloram, 1.6, 0.55; and dodecyl sodium sulfate, 2.8, 2.4. On the average, zebrafish were 2.6 times as tolerant as trout, and flagfish 4.2 times. Ratios of zebrafish/trout LC_{50}'s were considerably less variable than flagfish/trout LC_{50}'s. Considering the known variable response of rainbow trout and a maximum ratio of only 7.6 for exotic/trout LC_{50}'s, responses of zebrafish and flagfish were judged not sufficiently different from those of rainbow trout to discount either exotic species from further consideration as a potential standard test-fish. As a reference toxicant, sodium pentachlorophenate presented difficulties with analysis and availability. Dodecyl sodium sulfate showed no threshold of acute lethality for trout and 5-yr-old DSS had about one-third the toxicity of 1-year old DSS. Phenol met all criteria considered for a reference toxicant.

34019 Effects of naturally occurring aquatic organic fractions on cadmium toxicity to Simocephalus serrulatus (Daphnidae) and Gambusia affinis (Poeciliidae). Giesy, J.P. Jr.; Leversee, G.J.; Williams, D.R. (Savannah River Ecology Lab., Aiken, SC). *Water Res.;* **11**: No. 11, 1013-1020(1977).

Cadmium toxicity to Simocephalus serrulatus and Gambusia affinis in soft well water, highly organic pond water and well water containing various sized organic fractions isolated from pond water was determined and compared to Cd binding capacity of each water type. Pond organics were separated into three nomial molecular diameter fractions (>0.0183 μm; 0.0183 < > 0.0032 μm; 0.0032 < > 0.0009 μm) using ultrafiltration. Cadmium binding capacity was determined using selective ion electrodes. Pond water and organic fractions bound Cd, reducing the amount of free Cd^{2+} as determined by Cd selective ion electrode. Whole pond water reduced Cd toxicity to S. serrulatus but had little effect on Cd toxicity to G. affinis. The three larger molecular diameter organic fractions reduced Cd toxicity to S. serrulatus, while the smallest fraction slightly increased Cd toxicity. Cadmium 96 h LC_{50} values cannot be predicted from Cd binding capacities determined by selective ion electrode.

MAN

REFER ALSO TO CITATION(S) 33705, 33971

34020 (BNL—50761) **Hazards of organic working fluids.** Silberstein, S. (Brookhaven National Lab., Upton, N.Y. (USA)). Aug 1977. Contract EY-76-C-02-0016. 21p. Dep. NTIS, PC A02/MF A01.

We present several brief reviews on working fluids proposed for use in organic Rankine and bi-phase bottoming cycles. There are several general problems with many organic working fluids: flammability, toxicity, and a tendency to leak through seals. Besides, two of the proposed working fluids are to be used at temperatures above the manufacturer's maximum recommended temperature, and one is to be used in a way different from its customary usage. It may, in some cases, be more profitable to first seek alternative working fluids before committing large amounts of time and money to research projects on unsafe working fluids.

34021 (UCD—472-124, pp 186-191) **Scaling of NO_2 toxicity data from animals to humans.** Book, S.A.; Rosenblatt, L.S. Oct 1977. In Annual report, fiscal year 1977.

A preliminary effort at predicting NO_2 toxicity in people from data obtained from laboratory animals is presented. Recognizing the difficulty in extrapolating directly from a single species to human being, we have utilized data from mice, rats, guinea pigs, rabbits, and dogs to predict the response in people.

34022 Assessment of the limiting values of immissions from a medical point of view. Schlipkoeter, H.W. (Duesseldorf Univ. (Germany, F.R.). Medizinisches Inst. fuer Lufthygiene und Silikoseforschung; Duesseldorf Univ. (Germany, F.R.). Inst. fuer Hygiene). pp 5 of Energie und Umwelt. Essen, Germany, F.R.; Vulkan-Verl. (Jun 1977). (In German)

From 2. international fair and congress on techniques in environmental protection. International congress on energy and environment; Duesseldorf, Germany, F.R. (8 Feb 1977).

In connection with the assessment of immission limiting values from a medical point of view, the author points out the increased sensitivity of risk groups and the synergistic effect of noxious substances. As a characteristic example, disturbance of health through the breathing in of carbon monoxide is presented, which in the case of damaged coronary or blood vessels becomes visible at values which are only a fourth of those valid for healthy persons. On the basis of epidemiological studies the strong influence of smoking habits is pointed out. Finally, the influence of air pollution on the development of cancer is discussed. Determination of the carcino-embryonic antigens in the plasma shows rising values in dependence on cigarette consumption.

34023 Blood lead and cadmium determinations in soluene-350 (T.M.) digests. Barlow, P.J. (Univ. of Aston, Birmingham, AL). *Int. J. Environ. Stud.;* **11**: No. 1, 9-15(1977).

The use of Soluene-350 is investigated for the solubilization of bovine blood prior to analysis for lead and cadmium by graphite furnace atomic absorption spectrophotometry. The method is compared to acid digestion techniques and the advantages over these are discussed. The recovery of added lead and cadmium is greatly improved and because of the reduced handling and preparation of the blood, optimum values are obtained. The detection limit for this method is 0.002 ppM Pb and 0.001 ppM Cd and the relative standard deviations are 16 percent for lead and 19 percent for cadmium. The method combines the specificity and simplicity of atomic absorption analysis with the greatly increased sensitivity of the heated graphite tube atomiser to provide a simple and accurate method for blood lead and cadmium determination.

34024 Cadmium in deciduous teeth of Norwegian children. Fosse, G.; Berg-Justesen, N.P. (Univ. of Bergen Arstadveien, Norway). *Int. J. Environ. Stud.;* 11: No. 1, 17-27(1977).

Two thousand one hundred and sixty-nine deciduous teeth were collected from cities, industrialized areas, rural and fishing communities in several Norwegian counties. Teeth from Medieval Bergen were also included. Cd-analysis revealed that a third of the collected teeth had a level below 60 ng/g. It is suggested that this corresponds to a background level in an ideal uncontaminated environment. There was no correlation between industrialization or urbanization and tooth-Cd levels in Norway. Buskerud and Hordaland had the highest county levels. The study did not reveal the sources of Cd absorption or register undue burdens in Norwegian children. It is assumed, however, that different dental levels reflect different degrees of absorption, dependent on Cd-content in food, beverages and drinking water. The levels presented may serve as references in future research on Cd-absorption in Norway as it is believed that tooth-Cd can be used as an index to body burden.

OTHER ENVIRONMENTAL POLLUTANT EFFECTS

34025 (AD—045142) **Microwave exposure array: improved field measurements. Technical note.** Oliva, S.A.; Catravas, G.N. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Apr 1977. 15p. NTIS PC A02/MF A01.

Improved field measurements for Styrofoam and Plexiglas cages and a microwave exposure array previously designed and constructed at AFRRI are described. A new miniature isotropic electric field probe designed by the Bureau of Radiological Health was used. The new measurements demonstrated the effectiveness of the cages for microwave research. The microwave exposure array was shown to provide equal average power density to all exposed animals to within + or - 5 percent. (Author)

HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 33688

34026 Liability law. Amendment to the legal compensation regulations of August 16th, 1977 - BGBI 1977, I, p. 1577. *Gas- Wasserfach, Gas-Erdgas;* 118: No. 10, 33-34(Oct 1977). (In German).

On account of this amendment, the absolute liability, pursuant to section 1 a of the Reichshaftpfichtgesetz (RHG) so far only applicable for gas and electricity lines, has now also been entended to pipes for steam and liquids. Deviating from the present law, not only transport pipelines, but also the production pipelines are included. The maximum liability amounts were increased drastically. For injuries to persons, the compensation to be paid now is 30,000 DM at the most as against 15,000 DM previously. The highest sum for material damage, since 1939 unchanged at 25,000 DM, was put up to 100,000 DM.

34027 Influence of the mean dust concentrations in underground working places and of the dust composition on the occurrence of pneumoconiosis in miners of the Ostrava-Karvina mining region. Vitek, J. *Staub-Reinhalt. Luft;* 37: No. 8, 296-299(Aug 1977). (In German).

The hazards of pneumoconiosis occurring in underground working places of the Ostrava-Karvina mining region are assessed on the basis of data on the average concentration and composition of dust. For this purpose the results of concentration measurements made during a period of 12 years, and of dust analysis carried out during 8 years, were considered. The data on the most important dust components in the individual working places were correlated with the frequency of pneumoconiosis. It has been proved that the frequency of pneumoconiosis depends on the average total dust concentration in the places of work. Obvious correlations have also been found, however, between the average concentration of the main dust components and the frequency of pneumoconiosis. There is very little difference between the dust composition in the individual mines.

GEOSCIENCES

GEOLOGY AND HYDROLOGY

REFER ALSO TO CITATION(S) 32622, 32715, 32716, 32720, 32836, 33212, 33740

GEOPHYSICS

REFER ALSO TO CITATION(S) 32672, 34036

SEISMOLOGY AND TECTONICS

34028 Algorithms for correcting seismic image distortions produced by internal curvilinear strongly refracting interfaces. Vasil'ev, S.A.; Matveenko, G.V.; Urupov, A.K. *Prikl. Geofiz.;* No. 84, 80-99(1976). (In Russian).

Three types of algorithms are described for correcting distortions of dynamic seismic images caused by curvilinear intermediate boundaries. The testing of algorithms on models and field materials yield positive results. Ways of reducing machine time expenditures when algorithms are computed on computers are discussed. 12 illustrations, 4 titles.

34029 Frequency and geometric induction probing of stratified media by a device with vertically spaced sensors. Zhuravleva, R.B.; Titlinov, V.S. *Prikl. Geofiz.;* No. 84, 124-133(1976). (In Russian).

The possibility of sounding with a device having vertically spaced sensors is examined theoretically on the basis of analyzing the problem of a magnetic dipole field raised above a stratified medium. Simulation results confirm the preferability of using a vertical device instead of traditional induction sounding instruments for reducing side effects. 7 illustrations, 3 titles.

GEOPHYSICAL SURVEY METHODS

34030 Models of adjusting static corrections and efficiency of techniques for computing them from seismographs. Kiselev, V.S.; Chizhov, N.P.; Suslina, L.S. *Prikl. Geofiz.;* No. 84, 20-31(1976). (In Russian).

Various types of adjusting static corrections are examined: individual corrections for seismograph lines, variable corrections by horizons that are common to an entire time range, corrections averaged by shot points, corrections averaged by levels, and corrections found for a single level and disseminated over an entire time range. The nature of seisomograph line shifts corresponding to each type of correction is discussed. Experimental criteria are suggested for evaluating the effectiveness of wave discrimination in using the afore-mentioned correction types in common material. The use of individual corrections for lines that vary by horizons was found to be the most promising. 1 table, 4 illustrations, 3 titles.

34031 Use of sign bits for the digital processing of seismic data. Mushin, I.A. *Prikl. Geofiz.;* No. 84, 68-79(1976). (In Russian).

An analysis was made of seismic recordings subjected to sign coding. The characteristics of sign summation were constructed by evaluating the strength spectra of sign layouts and then compared to standard summation characteristics. The use of sign bits is indicated for analyzing material, computing kinematic parameters, constructing weight functions and for other transition stages from processing to interpreting seismic data. 4 illustrations, 7 titles.

34032 Use of electromechanical feedback in low-frequency seismic detectors. Shvedchikov, L.K. *Prikl. Geofiz.;* No. 84, 107-114(1976). (In Russian).

The effect of electromechanical feedback, proportional to the integral of the mobile mass of a seismic detector relative displacement was examined with respect to the instrument's frequency-amplitudinal and phase characteristics. The use of the indicated feedback leads to a wider bandpass in the seismic detector in the lower frequencies without changing its mechanical stability. 4 illustrations.

34033 Horizontal seismic record stacking of vertical seismic profiling. Shekhtman, G.A. *Prikl. Geofiz.;* No. 84, 115-123(1976). (In Russian).

A method is described for computing kinematic corrections in stacking of vertical seismic profiling in accordance with the common depth point principle. In the Moscow syncline a combination of this method with other methods for improving wave tracking has made it possible to identify weak deep reverberations confined to boundaries in Proterozoic strata. Quantitative evaluations of the degree of depression are cited for several short waves in horizontal stacking. 5 illustrations, 6 titles.

34034 Layer interpretation of magnetotelluric soundings of horizontal-stratified media by the amplitude-phase method. Svetov, B.S.; Khalizov, A.L. *Prikl. Geofiz.;* No. 84, 142-146(1976). (In Russian).

Layer interpretations of amplitude and phase impedance characteristics of magnetotelluric sounding of horizontal-stratified media is examined. This technique is an outgrowth of the layer interpretation method of N.G. Shkabarin and V.G. Gritsenko. In the former method, however, the section parameters at a known specific resistance of the upper layer are found directly rather than by selection. The algorithm also makes it possible to compute rho without obtain-

ing the high-frequency asymptote of the apparent resistance curve. 2 illustrations.

34035 Transmission of geophysical information in an on-line processing system. Sokhranov, N.N.; Ragimov, N.A.; Sarkisov, Yu.A., Gruzinov, V.A. *Prikl. Geofiz.;* No. 84, 204-209(1976). (In Russian).

Various principles are examined for constructing a data transmission system in the on-line processing of geophysics research results. At the present level of technical development, preference should be given to an arrangement with intermediate transmission. 3 illustrations, 8 titles.

GEOCHEMISTRY

REFER ALSO TO CITATION(S) 32717

34036 Use of thermodynamic excess functions in the Nernst Distribution Law. Holst, N.B. Jr. (Univ. of Illinois, Chicago). *Am. Mineral.;* 63: No. 1 and 2, 83-86(1978).

The Nernst distribution law, which is used by many authors in geology as the theoretical basis of geothermometry and trace-component distribution, is derived using excess functions. It is demonstrated that the free-energy term in the Nernst equation, as it is applied in many of these cases, is an excess function and describes the non-ideal behavior of the phases involved. It is then not necessry to introduce any assumptions concerning activities or activity coefficients, and one may use simple mole fractions instead. Analysis of system data in light of this allows one to make useful predictions concerning the accuracy of the data and the behavior of the system at elevated temperatures. Analysis is made of various data on the diopside-enstatite solvus as an example.

PHYSICS RESEARCH

ASTROPHYSICS AND COSMOLOGY

COSMIC RADIATION

34037 (CONF-740843—P2) **International conference on x-rays in space (cosmic, solar, and auroral x-rays). Volume 2.** (Calgary Univ., Alberta (Canada); National Research Council of Canada, Ottawa, Ontario). Apr 1975. 626p. of California, Alberta $40.00/set.

From International conference on x-rays in space; Calgary, Canada (14 Aug 1974).

The conference included studies of x-rays of cosmic, solar, and auroral origin. Invited talks, contributed papers and panel discussions are included in the proceedings. (GHT)

SOLAR PHENOMENA

REFER ALSO TO CITATION(S) 34037

34038 (AD—045017) **Solar atmospheric dynamics. Final report 19 Sep 74—30 Sep 76.** Stein, R.F. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). May 1977. Contract F19628-75-C-0013. 21p. NTIS PC A02/MF A01.

This study seeks to calculate the generation and propagation of Magneto-Acoustic Gravity (M.A.G.) waves in the solar atmosphere and their effect on the heating of the chromosphere and corona. A computer program has been written, which is capable of integrating the equations of motion of such waves, which are inherently three-dimensional. To simplify the equations, without seriously distorting the nature of the motions, we impose a fixed horizontal modal structure consisting of 6 waves propagating horizontally in a hexagonal pattern. These equations need to be integrated in time and only one spatial direction - the vertical. The program is currently being tested for the simpler case of non-vertically propagating acoustic-gravity waves. Skylab UV data is analyzed for evidence of acoustic pulses in the transition region. The steady state structure of the solar wind flow along a magnetic flux tube that diverges more rapidly than vertically was calculated. (Author)

34039 (AD—045114) **Observation and analysis of fe XVIII solar x-ray emission. Interim report.** Rugge, H.R.; Walker, A.B.C. Jr. (Aerospace Corp., El Segundo, Calif. (USA). Space Physics Lab.). 1 Sep 1977. Contract F04701-76-C-0077. 51p. NTIS PC A04/MF A01.

X-ray spectra from the solar corona, obtained with a crystal spectrometer on the OV1-17 satellite, are used to analyze Fe XVIII emission lines between about 14 and about 16A. The first comprehensive and accurate determinations of the coronal Fe XVIII wavelengths and relative intensities are made for the 2p-3d and 2p-3s transitions. Eighteen emission lines or line blends of Fe XVIII were observed and analyzed, including all X-ray lines previously observed in hot laboratory plasmas in this wavelength region. The measured OV1-17 wavelengths are in excellent agreement with the best laboratory measurements. The relative intensities for the Fe XVIII lines are used to deduce relative effective collision strengths for a number of transitions. The potential effects of cascades, to the 2s22p43d, 3p and 3s levels of Fe XVIII, on the interpretation of these relative collision strengths are discussed in detail. Calculations of the relative collision strengths using the modified Bethe approximation are compared to the OV1-17 deduced values.

34040 (CONF-780314—1) **Simulation experiments and solar wind sputtering.** Griffith, J.E.; Papanastassiou, D.A.; Russell, W.A.; Tombrello, T.A.; Weller, R.A. (California Inst. of Tech., Pasadena (USA)). 1978. 3p. Dep. NTIS, PC A02/MF A01.

From 9. lunar science conference; Houston, TX, USA (Mar 1978).

In order to isolate the role played by solar wind sputtering from other lunar surface phenomena a number of simulation experiments were performed, including isotope abundance measurements of Ca sputtered from terrestrial fluorite and plagioclase by 50-keV and 130-keV ^{14}N beams, measurement of the energy distribution of U atoms sputtered with 80-keV ^{40}Ar, and measurement of the fraction of sputtered U atoms which stick on the surfaces used to collect these atoms. 10 references. (JFP)

34041 (LA-UR—78-196) **Solar opacity and equation of state.** Huebner, W.F. (Los Alamos Scientific Lab., N.Mex. (USA)). 1978. Contract W-7405-ENG-36. 27p. (CONF-780117—1). Dep. NTIS, MF A01.

From Solar neutrino conference; Upton, NY, USA (5 Jan 1978).

Portions of document are illegible.

The disadvantages of radiative diffusion over radiative transfer in the photosphere as used in structure calculations is reemphasized. Uncertainties in the opacity due to uncertainties in chemical composition and in approximations of the physics are described and estimated. Internal consistency of equation of state and opacity is recommended.

34042 (PB—273167) **Collected data reports for stip (study of traveling interplanetary phenomena) interval II, 20 March—5 May 1976.** Coffey, H.E.; McKinnon, J.A. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Aug 1977. 325p. (UAG—61). NTIS PC A14/MF A01.

A summary of the significant solar-terrestrial events that occurred during the Retrospective World Interval of 20 March - 5 May 1976 has been prepared using data available at the present time. Although this period occurred at solar minimum, it was an active interval--one in which the principal events were associated with solar activity in a region at Carrington Longitude (about 45 degrees). Among the events summarized are the following: (1) solar activity during the period 20-23 March 1976 from a region behind the eastern limb of the sun; (2) a large geomagnetic storm with intense mid-latitude auroral activity of 26 March; (3) moderate solar particle intensities at the Earth from 26 through 31 March; and (4) a ground-level solar cosmic ray event on 30 April having a very hard spectrum. Sixty-seven individual data contributions were received from scientists from many countries after the Study of Traveling Interplanetary Phenomena (STIP) committee made a preliminary evaluation of the activity that occurred during STIP Interval II.

34043 (PB—273185) **Solar-geophysical data number 390, February 1977. Part i (prompt reports). Data for January 1977 — December 1976.** Leighton, H.I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Feb 1977. 122p. (SGD—390-Pt-1). NTIS PC A06/MF A01.

This prompt report provides data for January 1977 on: alert periods, daily solar indices, solar flares, solar radio waves, solar x-ray radiation, coronal holes, inferred IP magnetic field polarities, mean solar magnetic fields, and solar wind measurements. It also provides data for December 1976 on: daily solar activity centers, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices.

34044 (PB—273186) **Solar-geophysical data number 390, February 1977. Part II. (comprehensive reports). Data for August 1976—July 1976 and miscellanea.** Leighton, H.I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Feb 1977. 48p. (SGD—390-Pt-2). NTIS PC A03/MF A01.

This comprehensive report for August 1976, July 1976 and Miscellaneous data provides data on: active regions, synoptic solar maps, solar flares, solar radio waves, energetic solar particles and plasma, synoptic chart, abbreviated calendar record, and regional flare index.

34045 (PB—273209) **Solar-geophysical data No. 390. Supplement.** (National Geophysical and Solar-Terrestrial Data Center,

Boulder, Colo. (USA)). Feb 1977. 90p. (SGD—390-Suppl). NTIS PC A05/MF A01.

This pamphlet contains the description and explanation of the data in the monthly publication, Solar-Geophysical Data, compiled by the National Geophysical and Solar-Terrestrial Data Center (NGSDC) in Boulder, Colorado. Solar-Geophysical Data is intended to keep research workers abreast on a timely schedule of the major particulars of solar activity and the associated interplanetary, ionospheric, radio propagation and other geophysical effects.

PLANETARY PHENOMENA

REFER ALSO TO CITATION(S) 34040

ATMOSPHERIC PHYSICS

AURORAL AND IONOSPHERIC PHENOMENA

REFER ALSO TO CITATION(S) 34037

34046 (AD—045235) **Recent results on cleavage, bifurcation and cascade mechanisms in ionospheric plasma clouds. Memorandum report.** Ossakow, S.L.; Zalesak, S.T.; Zabusky, N.J. (Naval Research Lab., Washington, D.C. (USA)). Aug 1977. 21p. (NRL-MR—3579). NTIS PC A02/MF A01.

Cleavage, bifurcation, and cascade mechanisms are investigated in the evolution of striating ionospheric plasma clouds which are subject to the gradient drift instability. The numerical simulations are based on a one-level, two-dimensional model. An initially one dimensional Gaussian-like cloud with a smooth perturbation cleaves and spontaneously develops nonlinear bifurcations of the original perturbation thus forming secondary perturbations (striations). This represents a cascade from longer to shorter wavelength structures. An initially presteepened two dimensional cloud without initial perturbation cleaves and bifurcates to form a protuberance in the cleavage trough. These results demonstrate that cleavage is an inherent process in the evolution of striated ionospheric plasma clouds and plays an important role in the characterization of the late-time nuclear striation power spectrum. (Author)

MAGNETOSPHERIC PHENOMENA

34047 (AD—045021) **Inter-relationships of solar and interplanetary plasma, magnetic fields and energetic particles relevant to the prediction of solar-terrestrial disturbances.** Roelof, E.C.; Gold, R.E. (Johns Hopkins Univ., Silver Spring, Md. (USA). Applied Physics Lab.). 29 Jul 1977. Contract N00017-72-C-4401. 156p. (Scientific—2). NTIS PC A08/MF A01.

A summary is presented of research from the past year's efforts supported under this contract. The research covered interrelated topics in solar-terrestrial relationships. It is recommended that the present dual approach of investigations of solar-terrestrial events both of the past solar cycle as well as contemporary observations be continued. Comparison of phenomena among different phases of the solar cycle have identified several inter-relationships useful in the development of prediction techniques for geomagnetic disturbances and solar energetic particle events. (Author)

34048 (AD—045321) **Plasma waves in the polar cusp: observations from Hawkeye 1. Progress report.** Gurnett, D.A.; Frank, L.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jul 1977. Contracts N00014-76-C-0016;NAS1-11257. 71p. NTIS PC A04/MF A01.

In this paper we investigate the characteristics of plasma waves observed by the Hawkeye 1 spacecraft in the vicinity of the polar cusp. The primary types of plasma waves associated with the polar cusp are (1) a band of ULF-ELF magnetic noise extending from a few Hz to several hundred Hz, (2) a broad-band electrostatic emission extending from a few Hz to about 30 to 100 kHz, with maximum intensities at about 10 to 50 Hz, (3) electrostatic electron cyclotron waves near the electron gyrofrequency and (4) whistler-mode auroral hiss emissions. Of these various types of waves, only the ULF-ELF magnetic noise is uniquely associated with the cusp in the sense that the noise can be used as a reliable indicator of the polar cusp region. All of the other types of plasma waves occur in regions adjacent to the polar cusp as well as in the cusp itself.

34049 (EGG—1183-5075) **CHACHALACA: an L=6.6 field-line tracing experiment.** Broste, W.; Wright, D. (EG and G, Inc., Las Vegas, Nev. (USA)). Oct 1977. Contract EY-76-C-08-1183. 46p. Dep. NTIS, PC A03/MF A01.

CHACHALACA was an L = 6.6 field-line tracing experiment employing an explosive shaped charge barium payload injected at an altitude of 460 km over Poker Flats, Alaska at 12:58:01 UT (pre-dawn, local time), on 9 October 1972. Owing to less than nominal rocket performance, the detonation of the CHACHALACA payload took place below the planned altitude and hence within the Earth's U.V. shadow. Photoionization did not begin until the tip of the streak passed out of the U.V. shadow, a delay of 7 seconds. This delay in the onset of photoionization, coupled with a 10 degree misalignment of the payload axis with the local magnetic field, resulted in a broad diffuse ion streak 200 km wide 6 minutes after injection. The calculated number of ions in a particular velocity interval was significantly higher for CHACHALACA than for the earlier OOSIK experiment. The higher ion yield of the new skirted barium liner used in CHACHALACA compensated to some extent for the large crossfield spread, but it was still not possible to track the barium over the full length of the field line. Reliable triangulation was possible only for 11 minutes after injection.

ATOMIC, MOLECULAR, AND CHEMICAL PHYSICS

REFER ALSO TO CITATION(S) 33469

34050 **Atomic coreless Hartree-Fock pseudopotentials for atoms K through Zn.** Topiol, S.; Moskowitz, J.W.; Melius, C.F. (Chemistry Department, New York University, New York, New York 10003). *J. Chem. Phys.;* **68**: No. 5, 2364-2372(1 Mar 1978).

Using the coreless Hartree-Fock (CHF) pseudopotential approach we have generated pseudopotentials for the atoms K through Zn. Atomic calculations indicate that excitation energies and orbital energies using these pseudopotentials are in excellent agreement with ab initio Hartree-Fock calculations. Optimized small basis sets for use with these pseudopotentials are presented along with tests for these basis sets. When used in molecular calculations these coreless Hartree-Fock pseudopotentials should provide ab initio quality energies and wavefunctions while reducing the computational effort.

BEAMS AND THEIR REACTIONS

REFER ALSO TO CITATION(S) 34242

34051 (LBL—7133) **Atomic x-ray production by relativistic heavy ions.** Ioannou, J.G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1977. Contract W-7405-ENG-48. 136p. Dep. NTIS, PC A07/MF A01.

Thesis.

The interaction of heavy ion projectiles with the electrons of target atoms gives rise to the production, in the target, of K-, L- or higher shell vacancies which are in turn followed by the emission of characteristic x-rays. The calculation of the theoretical value of the K- and L-shells vacancy production cross section was carried out for heavy ion projectiles of any energy. The transverse component of the cross section is calculated for the first time in detail and extensive tables of its numerical value as a function of its parameters are also given. Experimental work for 4.88 GeV protons and 3 GeV carbon ions is described. The K vacancy cross section has been measured for a variety of targets from Ti to U. The agreement between the theoretical predictions and experimental results for the 4.88 GeV protons is rather satisfactory. For the 3 GeV carbon ions, however, it is observed that the deviation of the theoretical and experimental values of the K vacancy production becomes larger with the heavier target element. Consequently, the simple scaling law of Z_1^2 for the cross section of the heavy ion with atomic number Z_1 to the proton cross section is not true, for the K-shell at least. A dependence on the atomic number Z_2 of the target of the form $(Z_1 - \alpha Z_2)^2$, instead of Z_1^2, is found to give extremely good agreement between theory and experiment. Although the exact physical meaning of such dependence is not yet clearly understood, it is believed to be indicative of some sort of screening effect of the incoming fast projectile by the fast moving in Bohr orbits K-shell electrons of the target. The enhancement of the K-shell ionization cross section by relativistic heavy ions on heavy targets is also discussed in terms of its practical applications in various branches of science and technology.

34052 **Device for providing high-intensity ion or electron beam.** McClanahan, E.D.; Moss, R.W. (to Energy Research and Development Administration). US Patent 4,046,666. 6 Sep 1977. Filed date 7 May 1976. 8p.

PAT-APPL-684,418.

A thin film of a low-thermionic-work-function material is maintained on the cathode of a device for producing a high-current, low-pressure gas discharge by means of sputter deposition from an auxiliary electrode. The auxiliary electrode includes a surface with a low-work-function material, such as thorium, uranium, plutonium or one of the rare earth elements, facing the cathode but at a disposition and electrical potential so as to extract ions from the gas discharge and sputter the low-work-function material onto the cathode. By continuously replenishing the cathode film, high thermionic emissions and ion plasmas can be realized and maintained over extended operating periods. 2 figures, 3 tables.

ATOMIC AND MOLECULAR PROPERTIES

34053 (UR—3490-1247) **Experimental investigation about attachment processes of atoms and ions in the size range < 0.1 μm.** Porstendoerfer, J.; Mercer, T.T. (Rochester Univ., N.Y. (USA). Dept. of Radiation Biology and Biophysics). 1977. Contract EY-76-C-02-3490. 7p. (CONF-7710119—1). Dep. NTIS, PC A02/MF A01.

From Gesellschaft fur aerosolforschung (GAF) meeting; Karlsrhue, F.R. Germany (22 Oct 1977).

Results of an investigation of the attachment process of atoms and ion in the size range between 0.009 to 4 μm on a particle or droplet surface are presented. It is again shown that the experimental values are adequately predicted by the diffusion attachment theory under gas kinetic consideration, if the sticking probability of Rn and Tn decay products is S = 1. 12 references. (JFP)

COLLISION PHENOMENA

34054 **K vacancy production by Ne and Ar beams with energies from 0.7 to 8 MeV.** Jones, K.W. (Strasbourg-1 Univ., 67 (France); Brookhaven National Lab., Upton, N.Y. (USA)); Jundt, F.C.; Guillaume, G.; Fintz, P. (Strasbourg-1 Univ., 67 (France)). pp 328-329 of International conference on the physics of electronic and atomic collisions. 10th. Paris, 21-27 July 1977. Vol. 1. Paris, France; Commissariat a l'Energie Atomique (1977).

From 10. international conference on the physics of electronic and atomic collisions; Paris, France (21 Jul 1977).

See CONF-770746—.

34055 (IPPJ-DT—48) **Atomic-process cross section data 1. Processes involving hydrogen isotopes (H,D,T) and their ions, and photons and electrons.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1974. 219p. (In Japanese). Dep. NTIS (US Sales Only), PC A10/MF A01.

Compiled by the Data Study Group, the data are intended for fusion plasma physics research. Cross sections of the latest experimental and theoretic studies cover the processes involving H,D,T as principal plasma materials as well as photons and electrons: emission and absorption of electromagnetic wave, electron collision, ion collision, recombination, neutral atom mutual collision, etc. Edition is so made to enable the future renewal by users.

ATOMIC AND MOLECULAR THEORY

34056 **Possibility of studying molecular homogeneous linewidth using coherent anti-stokes Raman scattering.** Khoo, I.C.; Yeung, E.S. (Ames Lab., IA). *Opt. Commun.;* **22**: No. 1, 83-86(Jul 1977).

The theory of coherent four wave mixing is reviewed for the case where the initial state involved is homogeneously broadened. Because of this broadening, the generated wave is broadened and is shown to be able to grow with the incident waves for an interaction length which obeys certtain restrictions. The possibility and usefulness of using this type of scattering to study molecular homogeneous width is pointed out.

GENERAL FLUID DYNAMICS

34057 (FEI—631) **Averaged equation of liquid flow in a porous body consisting of rod bundles.** Yur'ev, Yu.S.; Kolmakov, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

An attempt has been made to use a model of a porous body to investigate the hydrodynamic properties and heat exchange in the rod systems (cores of reagents, interpipe space of heat exchangers). The problem of a stationary flow of a viscous fluid in the lattice made of flat thin laminae is discussed. The equations are obtained by the way of geometrical averaging the Navier-Stokes equations. The solution obtained is extended to cover the general case of a three-dimensional flow in the regular rod lattices. The volumetric resistance forces, viscous interaction forces and inertia forces are analyzed. To solve the system obtained, one should know the empiric resistance factors in case of lateral and transverse flowing around the rod lattices, the average viscosity for a given volume with due regard for the turbulent component and the momentum factors.

34058 **Division of gas between bubble and interstitial phases in fluidised beds of fine powders.** Rowe, P.N.; Santoro, L.; Yates, J.G. (Univ. Coll., London). *Chem. Eng. Sci.;* **33**: No. 1, 133-140(1978).

The division of gas flow between the two phases of a fluidized bed of commercial catalyst powder has been determined from measurements of interstitial phase voidage and bed height over a wide range of gas velocities. Voidage measurements were made by comparing the x-ray absorption of the interstitial phase of the freely bubbling catalyst with that of a calibration wedge containing the same material. X-ray photography was also used in the measurement of bed height. Three batches of catalyst powder containing different amounts of "fines" were examined. The results clearly demonstrate that increasing the fines content of a fluidized powder leads to an increase in the relative proportion of gas flowing interstitially at all fluid velocities. Furthermore the interstitial gas flow is shown to be up to 25 times greater than the minimum fluidization value for the powder containing the highest proportion of fines. The implications of this for the two-phase theory of fluidization and for the design and operation of fluidized bed reactors is discussed.

34059 **Mixing of coarse particles in fluidized beds with tube bundles.** Livshits, Yu.E.; Tamarin, A.I.; Teplitskii, Yu.S. *Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk;* No. 4, 83-87(1977). (In Russian).

Measurements were made of the effective axial diffuson coefficient in freely bubbling fluidized beds and those packed with tube bundles. The experiments were carried out in a column 40 x 25 cm in cross-section and 200 cm in height. The solids used were glass spheres 1.75 mm in dia and sand spheres 0.63 mm in dia. A correlation is proposed to generalize the experimental data.

34060 **Axial mixing of the solid phase in fluidized beds. Free beds.** Teplitskii, Yu.S.; Tamarin, A.I. *Vestsi Akad. Navuk BSSR, Ser. Fiz.-Energ. Navuk;* No. 4, 88-94(1977). (In Russian).

The present paper presents the experimental results for axial mixing and its relation to bubbling phenomena. A study has been made of the effective axial thermal conductivity and time-averaged solid mass flow in gas fluidized beds 15, 30 and 70 cm in diameter.

HIGH ENERGY PHYSICS

34061 (BNL—50598) **Proceedings of particles and fields, 1976.** Gordon, H.; Peierls, R.F. (eds.). (Brookhaven National Lab., Upton, N.Y. (USA)). 1976. Contract EY-76-C-02-0016. 445p. (CONF-761045—). Dep. NTIS, PC A15/MF A01.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

The conference contained 23 papers, two of which appeared previously in ERA. Separate abstracts were prepared for 21 papers. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - EXPERIMENTAL

34062 (BNL—50598, pp A33-A42) **New particle production by e^+e^- colliding beams.** Schwitters, R.F. (Stanford Univ., CA). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

A brief survey is given of the status of charmonium spectroscopy, the question of a heavy lepton, and charm particle production. 37 references. (JFP)

34063 (BNL—50598, pp C25-C52) **Review of electron and muon scattering.** Mo, L.W. (Virginia Polytechnic Inst. and State Univ., Blacksburg). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

The new experimental results are summarized on the questions of scaling, nucleon structure functions, hadron distributions, and other related subjects in electron/muon scattering. 10 references. (JFP)

34064 (ORO—5096-3) **High energy physics. Progress report, April 1, 1977—March 31, 1978.** Phillips, G.C.; Roberts, J.B. Jr. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). 1978. Contract EY-76-S-05-5096. 26p. Dep. NTIS, PC A03/MF A01.

During the past contract year progress was made in studies of high energy interactions of elementary particles, and in particular, of their spin dependence. Continued analysis of earlier experiments (ZGS E-395 and E-418) occurred during the year. Experiment E-415 was continued into the year and completed in August. A new experiment E-437 was completed and data analysis was continued throughout the year. In addition, progress was made in planning and construction for future ZGS experiments E-434, E-440, and P-425: namely, the design and construction of a new polarized proton target (PPT VI) at Argonne, and development of new detector systems. There was major participation in the Workship on Future Possibilities for High Energy Polarized Beams, held in Ann Arbor, Michigan, and in the Fermilab Meson Lab Workshop. During the year, three invited papers were presented at meetings, two papers were published in The Physical Review, two have been submitted for publication to the Physical Review, and a letter was submitted to

Physics Letters. Some of this work was done in collaboration with the University of Minnesota Group under the direction of Professor K. Ruddick. During the year Dr. H. E. Miettinen joined the faculty as Visiting Assistant Professor. A list of publications is included.

WEAK INTERACTIONS

34065 (BNL—50598, pp A1-A12) **Review of direct lepton production in hadron collisions.** Piroue, P.A. (Princeton Univ., NJ). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

The experimental data on single direct lepton production in hadron collisions are reviewed. The general picture emerging from recent studies of muon production is one in which prompt muons are produced principally in pairs arising from a $\mu\mu$ continuum and the decay of vector mesons into μ pairs. The origin of the continuum is still unclear.

34066 (BNL—50598, pp C1-C24) **Weak decay processes.** Pondrom, L.G. (Univ. of Wisconsin, Madison). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

This discussion is limited to decays of charged and neutral K mesons. The present experimental situations regarding $K \to l\nu$, $K \to \pi l\nu$, $K \to \pi\pi\gamma$, K^0/sub L/ $\to \mu^+\mu^-$, and $K^+ \to \pi^+e^+e^-$ are reviewed.

34067 **Recent results from counter-spark chamber ν experiment at BNL.** Lee, W.; Maddry, E.; Sippach, W.; Sokolsky, P.; Teig, L. (Columbia Univ., New York (USA)); Chapin, T.; Bross, A.; Nodulman, L.; O'Halloran, T.; Pang, C.Y. (Illinois Univ., Urbana (USA)). pp 319-332 of Proceedings of the international neutrino conference Aachen 1976. Session 2: weak neutral currents. Faissner, H.; Reithler, H.; Zerwas, P. (eds.). Braunschweig, Germany, F.R.; Vieweg (1977).

From International neutrino conference; Aachen, F.R. Germany (8 Jun 1976).

See CONF-760671—.

In this talk I will discuss the following subjects: 1. the first observation of the reaction ν/sub μ/ + p $\to$ ν/sub μ/ + p and the measurement of the ratio R/sub el/ = sigma (ν/sub μ/ + p $\to$ ν/sub μ/ + p/ to sigma (ν/sub μ/ + n $\to \mu^-$ + p); 2. the study of the reactions ν/sub μ/ + N $\to$ ν/sub μ/ + N' + π^0 and anti ν/sub μ/ + N $\to$ anti ν/sub μ/ + N' + π^0; 3. the observation of ν/sub μ/ + N $\to \mu$ + e + ...

34068 (LBL—7255) **Some properties of the hadronic system in neutrino interactions.** Lynch, G.R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1977. Contract W-7405-ENG-48. 16p. (CONF-771089—5). Dep. NTIS, PC A02/MF A01.

From Particles and fields meeting; Argonne, IL, USA (6 Oct 1977).

A review is given of selected topics on properties of hadronic systems in neutrino interactions. These topics are inclusive distributions, dilepton events, and exclusive channels. 20 references. (JFP)

STRONG BARYON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 34068

34069 (BNL—50598, pp A13-A29) **Photoproduction of new particles.** Knapp, B.C. (Columbia Univ., New York). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

The current results presented on the new particle production are the anti $\Lambda \to n\pi$ giving striking confirmation of theoretical predictions of charmed baryon structure and the famous $\Delta S = -\Delta Q$ event. Also the D^0's are photoproduced from nuclear targets and decay to K/sub S/4π. An upper limit is set on the branching ratio. Lastly a broad six-pion resonance was observed. It is inferred that this observation was the six-pion decay of a vector meson of roughly three times the rho meson mass. (JFP)

STRONG MESON-INDUCED INTERACTIONS

REFER ALSO TO CITATION(S) 34068, 34069

34070 (SLAC-PUB—2000) **Properties of the D mesons.** Feldman, G.J. (Stanford Linear Accelerator Center, Calif. (USA)). Aug 1977. Contract EY-76-S-03-0326. 36p. Dep. NTIS, PC A03/MF A01.

A review is given of nonleptonic decays of D mesons. Measurements of the psi (3772), the accurate determination of D masses and their consequences, inclusive measurements and tagged events are given. 36 references. (JFP)

34071 (SLAC-PUB—2068) **Charmed particle spectroscopy.** Feldman, G.J. (Stanford Linear Accelerator Center, Calif. (USA)). Dec 1977. Contract EY-76-S-03-0326. 50p. Dep. NTIS, PC A03/MF A01.

Lectures are presented in a review of the properties of charmed particles in the time since their definitive identification. The emphasis is on the recent work on D resonance decay, mass, and absolute branching ratio as determined from the decays of the psi (3772). Also the total hadronic cross section, spin and parity determinations, D^0-D^{-0} mixing, and F mesons and charmed baryons are considered. 52 references. (JFP)

PARTICLE INTERACTIONS AND PROPERTIES - THEORETICAL

REFER ALSO TO CITATION(S) 33618

GENERAL

34072 (BNL—50598, pp B19-B.34) **New particle phenomenology.** Gilman, F.J. (Stanford Univ., CA). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

The consequences of having a new heavy quark in addition to the u, d, and s quarks (sometimes denoted q) and particularly the resulting c anti c, c anti q, and cqq spectroscopy. This is done in the general framework of a picture of matter as composed of spin-$^1/_2$ leptons and quarks, the latter bound together by an SU(3) octet of vector gluons coupled to the three color degrees of freedom of the quarks to form the color singlet hadrons. The growing evidence for a heavy lepton is reviewed, and then the likelihood of even more heavy quarks and the resulting direction of spectroscopy in the future are examined. 103 references. (JFP)

WEAK INTERACTIONS

REFER ALSO TO CITATION(S) 33619

STRONG INTERACTIONS, GENERAL

34073 (ANL-HEP-CP—78-04) **Theory of spin dependence at very high energies.** Thomas, G.H. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 14p. (CONF-7710115—2). Dep. NTIS, PC A02/MF A01.

From Workshop on polarized proton beams; Ann Arbor, MI, USA (18 Oct 1977).

The point of view taken is to introduce a number of topics for possible discussion during the course of this workshop. Some of the theoretical expectations for polarization phenomena are reviewed assuming that hadrons are composite. Polarization phenomena are considered from an S-matrix point of view.

34074 (COO—2978-3) **Inelastic strong interactions at high energies. Annual progress report, June 1, 1977—May 31, 1978.** Suranyi, P. (Cincinnati Univ., Ohio (USA)). Feb 1978. Contract EY-76-S-02-2978. 12p. Dep. NTIS, PC A02/MF A01.

Certain classical solutions of the field equations, hereafter sectons, were shown to dominate inclusive and semi-inclusive cross sections which are proportional to the absolute square of the Fourier transform of these solutions in zeroth order of a model independent approximation scheme. Higher order approximations are obtained by the loop expansion method, or by a perturbation expansion around the classical solutions. Sectons were shown to be associated with nonvanishing values of two conserved topological quantum numbers (that vanish for solitons). An application to phi^4 field theory gave an inclusive cross section with Feynman scaling, a total cross section with a power dependence on the primary energy and a Poisson-like multiplicity distribution. An SU(2) invariant Reggeon field theory containing three reggeon multiplets, one with negative mass, was studied in the classical approximation with zero transverse dimensions. A solution was found, qualitatively similar to a solution of supercritical Pomeron theory, giving a constant local cross section and decreasing cross sections for quantum number exchanges. A method, that allows the calculation of critical parameters of a lattice based on the strong coupling expansion of the finite renormalization group equations, was worked out and shown to give excellent results for a two dimensional lattice.

34075 (RLO/2230/T4—197) **Quark-parton model in the fragmentation region. Period covered: November 17, 1976—August 16, 1977.** Hwa, R.C. (Oregon Univ., Eugene (USA)). 1977. Contract EY-76-S-06-2230-004. 8p. (CONF-770319—10). Dep. NTIS, PC A02/MF A01.

From 12. Rencontre de Moriond; Haute-Savoie, France (6 Mar 1977).

By considering quark-antiquark recombination at low p/sub T/, the quark-parton model is extended to the fragmentation region. Agreement of the calculated results with the data is excellent.

34076 (SLAC-PUB—2065) **Hadron spectroscopy and the new particles.** Gilman, F.J. (Stanford Linear Accelerator Center, Calif. (USA)). Dec 1977. Contract EY-76-S-03-0326. 44p. (CONF-770889—1). Dep. NTIS, PC A03/MF A01.

From Banff Summer Institute on particles and fields; Alberta, Canada (26 Aug 1977).

Various properties of the new particles are discussed and the related theories considered. The quark model, mesons, baryons, and decay processes are treated. 100 references. (JFP)

34077 (SLAC-PUB—2077) **Composite hadrons and relativistic nuclei.** Blankenbecler, R. (Stanford Linear Accelerator Center, Calif. (USA)). Jan 1978. Contract EY-76-S-03-0326. 69p. Dep. NTIS, PC A04/MF A01.

Lectures are presented describing a model of hadronic scattering at large momentum transfer, either transverse or longitudinal. This model emphasizes in this regime the importance of forces involving the interchange of constituents of the hadrons, hence its name, the constituent interchange model CIM. The CIM is a rearrangement of standard perturbation theory to take into account the fact that the binding force is very strong in color singlet states (singlet dominance). The hard scattering expansion, incoherence problems, nuclear wave functions and counting rules, interaction between nuclei, pion and proton yields and form factors, structure functions and nonscaling, massive lepton pairs, hadrons at large transverse momentum, and quark-quark scattering are treated. 49 references. (JFP)

STRONG INTERACTIONS, BARYON NO.=1

34078 (RLO/2230/T4—198) **Nonscaling hard collision model. Period covered: November 17, 1976—August 16, 1977.** Hwa, R.C. (Oregon Univ., Eugene (USA)). 1977. Contract EY-76-S-06-2230-004. 10p. (CONF-770319—9). Dep. NTIS, PC A02/MF A01.

From 12. Rencontre de Moriond; Haute-Savoie, France (6 Mar 1977).

The nonscaling behavior in large-p/sub T/ processes is used to infer the existence of a scale in the multi-GeV range. That scale is determined in the description of the scaling violation of the deep inelastic lepton scattering. By connecting the two nonscaling behaviors, the pion and proton inclusive cross sections at large p/sub T/ are found to be well described by the hard collision model. A no-parameter fit can be given for the opposite-side correlation at 90°. Since the basic subprocess is quark-quark scattering, there are therefore two large-angle jets, which is consistent with experiment. Thus the nonscaling hard collision model is compatible with all data on large p/sub T/. The scale parameter is around 7 GeV.

STRONG INTERACTIONS, BARYON NO. GREATER THAN 1

REFER ALSO TO CITATION(S) 34078

34079 (ANL-HEP-CP—78-03) **One photon exchange processes and the calibration of polarization of high energy protons.** Margolis, B.; Thomas, G.H. (Argonne National Lab., Ill. (USA)). Jan 1978. Contract W-31-109-ENG-38. 7p. (CONF-7710115—3). Dep. NTIS, PC A02/MF A01.

From Workshop on polarized proton beams; Ann Arbor, MI, USA (18 Oct 1977).

Polarization phenomena in small momentum transfer high energy one-photon exchange processes in the reaction $p + A \rightarrow X + A$ where A is a complex nucleus and X is anything are examined. It is shown that these polarizations can be related directly to photoproduction polarization effects in the reaction $\gamma + p \rightarrow X$ at low energies. Explicit formulae are written for polarization effects in the case where $X \rightarrow \pi^0 + p$.

PARTICLE INVARIANCE PRINCIPLES AND SYMMETRIES

GENERAL

34080 (BNL—50598, pp B35-B44) **Unification of strong, electromagnetic and weak interactions through exceptional groups.** Guersey, F. (Yale Univ., New Haven). 6 Oct 1976.

From Division of particles and fields conference; Upton, NY, USA (6 Oct 1976).

In Proceedings of particles and fields, 1976.

The validity of a field theory of quarks and leptons based on the group SU(2) x U(1) x SU(3) with the surviving exact subgroup U(1) x SU(3) associated with the photon and eight color gluons as zero mass gauge bosons with spin 1 is assumed. Unification of fundamental interactions, charge space as an exceptional quantum mechanical space, local gauge groups as automorphism groups of local algebras of observables, general features of the gauge field theory based on E_7, and possible quark-lepton assignments and weak interaction phenomenology are considered. 55 references. (JFP)

APPLICATIONS TO STRONG INTERACTIONS

34081 (ANL-HEP-PR—77-65) **Condensation in the Feynman—Wilson fluid: upsilon, psi, and Centauro.** Arnold, R.C. (Argonne National Lab., Ill. (USA)). Sep 1977. Contract W-31-109-ENG-38. 14p. Dep. NTIS, PC A02/MF A01.

High multiplicity hadron production amplitudes with long-range rapidity correlations from Regge cuts can exhibit dramatic condensation phenomena in rapidity and charge variables. The rapidity structures would appear as metastable heavy hadrons such as Upsilon or Psi. Charge-space condensation (spontaneous symmetry breakdown) would produce phenomena resembling observed "Centauro" cosmic-ray events. The conditions necessary for appearance of such phenomena are linked to the conditions for generating electromagnetic and weak interactions through spontaneous strong-interaction symmetry breakdown.

FIELD THEORY

REFER ALSO TO CITATION(S) 34074

SCATTERING THEORY

REFER ALSO TO CITATION(S) 34074

PHYSICS RESEARCH (CONT.)

NUCLEAR PHYSICS

34082 (ANL/NDM—41) **Energy-averaged neutron cross sections of fast-reactor structural materials.** Smith, A.; McKnight, R.; Smith, D. (Argonne National Lab., Ill. (USA)). Feb 1978. Contract W-31-109-ENG-38. 65p. (CONF-771233—1). Dep. NTIS, PC A04/MF A01.

From Meeting on neutron data of structural materials; Geel, Belgium (5 Dec 1977).

The status of energy-averaged cross sections of fast-reactor structural materials is outlined with emphasis on U.S. data programs in the neutron-energy range 1-10 MeV. Areas of outstanding accomplishment and significant uncertainty are noted with recommendations for future efforts. Attention is primarily given to the main constituents of stainless steel (e.g., Fe, Ni, and Cr) and, secondarily, to alternate structural materials (e.g., V, Ti, Nb, Mo, Zr). Generally, the mass regions of interest are A approximately 50 to 60 and A approximately 90 to 100. Neutron total and elastic-scattering cross sections are discussed with the implication on the non-elastic-cross sections. Cross sections governing discrete-inelastic-neutron-energy transfers are examined in detail. Cross sections for the reactions (n;p), (n;n′,p), (n;α), (n;n′,α) and (n;2n′) are reviewed in the context of fast-reactor performance and/or diagnostics. The primary orientation of the discussion is experimental with some additional attention to the applications of theory, the problems of evaluation and the data sensitivity of representative fast-reactor systems.

NUCLEAR PROPERTIES AND REACTIONS, A=6-19, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

34083 (COO—3496-65, pp 131-145) **Systematics of interaction and strong absorption radii determined from heavy-ion elastic scattering.** Birkelund, J.R.; Huizenga, J.R. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

Various methods for determining the strong absorption radius for light and intermediate mass nuclei are discussed. It is found that this determination in terms of the half-density radii of the target and projectile is more accurate over the whole range of available data than the other simple parametrizations. 62 references. (JFP)

34084 (ORNL-tr—4605) **Evaluation of neutron cross sections for ^{19}F in the energy range from 100 keV to 20 MeV.** Sugi, T. 1977. Translation by T.E. Ohtani of JAERI-M—7253. 51p. NTIS, MF A01.

Portions of document are illegible.

Because of the possibility of using molten fluoride salts in nuclear fusion reactors, neutron cross sections for ^{19}F were evaluated from 100 keV to 20 MeV to provide necessary design information. The cross sections evaluated were total, elastic and inelastic scattering cross sections; (n,2n) reaction cross sections; cross sections for the emission of charged particles in reactions of the types (n,α), (n,p), (n,d), (n,t), (n,αn'), (n,n'α), (n,pn'), and (n,n'p); and (n,γ) reaction cross sections. Experimental points were used in the evaluation where available; 1313 measured points were employed. The evaluation is discussed in detail; the results are plotted and tabulated. 22 figures, 5 tables. (RWR)

NUCLEAR PROPERTIES AND REACTIONS, A=90-149, EXPERIMENTAL

REFER ALSO TO CITATION(S) 34083

RADIOACTIVE DECAY

34085 (IS-T—812) **Decay of mass-separated ^{118}Ag to levels in ^{118}Cd.** Margetan, D.R. (Ames Lab., Iowa (USA)). Apr 1978. Contract W-7405-ENG-82. 61p. Dep. NTIS, PC A04/MF A01.

Thesis.

A study of the gamma-ray de-excitation following the beta decay of ^{118}Ag using the TRISTAN on-line isotope separator is reported. Gamma-ray singles, gamma-gamma coincidence, and gamma-ray multiscale measurements were made using Ge(Li) detectors. A total of 52 gamma rays were observed in the decay of ^{118}Ag. Thirty-eight of these were placed in a level scheme for ^{118}Cd consisting of 20 excited states up to 3382 keV. Gamma-ray multiscale measurements indicated that ^{118}Ag has an isomeric state at 128 keV with a half-life of 2.0 +- 0.2 seconds. The ground state half-life is 3.76 +- 0.15 seconds. The ^{118}Ag decay scheme is compared with a previous decay study. The level scheme systematics are discussed and compared with recent collective model calculations.

ENERGY LEVELS AND TRANSITIONS

REFER ALSO TO CITATION(S) 34085

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34083

34086 (CONF-771233—3) **Resonance parameters, capture γ-rays and reaction mechanism in $^{98,100}Mo$ + n.** Weigmann, H.; Harvey, J.A.; Macklin, R.L.; Raman, S.; Slaughter, G.G. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements; Oak Ridge National Lab., Tenn. (USA)). 1977. Contract W-7405-ENG-26. 16p. NTIS, MF A01.

From Meeting on neutron data of structural materials; Geel, Belgium (5 Dec 1977).

Portions of document are illegible.

In recent years the mechanism of the neutron capture reaction has found wide interest due to the detection of "non-statistical" effects. Among the most distinct examples for non-statistical effects in resonance neutron capture are the strong p-wave resonances in the Mo isotopes ^{92}Mo and ^{98}Mo. Especially in the case of ^{98}Mo, it has been shown that the large partial radiative widths can be quantitatively explained on the basis of a simple version of the valence model. Like ^{98}Mo, also the neighboring isotope ^{100}Mo shows strong p-wave resonances at low neutron energies. Therefore, ^{100}Mo provides another interesting test case for the validity of the valence model. Thus neutron resonances in ^{100}Mo were studied at the Oak Ridge electron linear accelerator time-of-flight facility. The transmission of two oxide samples (97.4% ^{100}Mo) was measured at an 80 m flight path and the neutron capture cross section was measured at 40 m. Resonance analysis yielded parameters of 123 resonances. Capture γ-ray spectra from 11 resolved resonances have been measured with a Ge(Li)-detector at a 10 m flight path. Contrary to the neighboring nuclei, partial radiative widths of strong p-wave resonances are not in agreement with valence model predictions.

34087 (COO—3496-65, pp 128-129) **Dependence of nuclear orbiting and charge exchange on bombarding energy in the ^{144}Sm + ^{84}Kr reaction.** Mignerey, A.C. (Argonne National Lab., IL); Raich, D.G.; Wolf, K.L.; Boudrie, R.L.; Schroeder, W.U.; Birkelund, J.R.; Huizenga, J.R.; Viola, V.E. Jr. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

The dependence of nuclear orbiting and charge exchange on bombarding energy for 470 to 720-MeV ^{84}Kr ions on a ^{144}Sm target is studied. The differential cross sections and variances of the charge distributions are found, and the energy loss associated with each nucleon exchanged for total dissipated energies from 10 to 70 MeV is determined. (JFP)

34088 (COO—3496-65, pp 130) **Possible static deformation effects in ^{84}Kr- and ^{86}Kr- induced reactions on targets of ^{144}Sm and ^{154}Sm.** Raich, D.G.; Mignerey, A.C.; Wolf, K.L.; Boudrie, R.L.; Roche, C.T.; Schroeder, W.U.; Birkelund, J.R.; Huizenga, J.R.; Viola, V.E. Jr. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

The apparent static deformation effect in $^{84,86}Kr$ induced reactions of $^{144,154}Sm$ was studied at energies of 470 to 720 MeV. Cross section variations are discussed. The possibility that this effect is due to a fusion-fission mechanism is ruled out. 1 reference. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, THEORETICAL

NUCLEAR REACTIONS AND SCATTERING

34089 (COO—3496-65, pp 75-94) **Interaction times for damped heavy-ion collisions.** Schroeder, W.U.; Birkelund, J.R.; Huizenga, J.R.; Wolf, K.L.; Viola, V.E. Jr. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

Sticking and nonsticking models are used to calculate the angular-momentum-dependent interaction times for the reactions ^{165}Ho + ^{84}Kr, ^{209}Bi + ^{84}Kr, and ^{209}Bi + ^{136}Xe. The angular momenta and differential cross sections are plotted. Five references. (JFP)

34090 (COO—3496-65, pp 111-127) **Mechanisms of kinetic energy dissipation.** Huizenga, J.R.; Birkelund, J.R.; Schroeder, W.U.; Wolf, K.L.; Viola, V.E. Jr. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

The microscopic time scale provided by the nucleon exchange process is used to study the energy dissipation mechanism in various heavy ion reactions. 23 references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=150-189, EXPERIMENTAL

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34088

34091 (COO—3496-65, pp 95-110) **Diffusion coefficients in heavy ion reactions.** Birkelund, J.R.; Schroeder, W.U.; Huizenga, J.R.; Wolf, K.L.; Viola, V.E. Jr. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

Experimental charge distributions for the reactions of xenon 136 and krypton 84 with bismuth 209 and holmium 165 are suggestive of a diffusion process and were analyzed with a Fokker-Planck equation in terms of the variance. Differential cross sections, charge distribution, interaction time, angular momentum, and diffusion coefficients for the sticking and nonsticking models are among the quantities considered. Four references. (JFP)

NUCLEAR PROPERTIES AND REACTIONS, A=190-219, EXPERIMENTAL

REFER ALSO TO CITATION(S) 34089, 34090

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34091

34092 (COO—3496-65, pp 146-167) **Bombarding energy dependence of the reaction ^{209}Bi + ^{136}Xe.** Wilcke, W.; Hoover, A.D.; Birkelund, J.R.; Schroder, W.U.; Huizenga, J.R.; Mignerey, A.; Raich, D.G.; Wolf, K.L.; Viola, V.E. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

The system ^{136}Xe on ^{209}Bi was reexamined at a lower energy than previously done. The energy used, 900 MeV, is an energy drop which reduces the available energy above the Coulomb barrier in

the center-of-mass system by a factor of two. The elastic scattering and differential cross sections, strong absorption radius, and angular distribution are discussed. Two references. (JFP)

34093 (ORO—4699-4) **Study of the two-body dissociation of light nuclei in nuclear fields. Progress report, January 1, 1977—December 31, 1977.** Kirk, P.N.; Huggett, R.W. (Louisiana State Univ. and Agricultural and Mechanical Coll., Baton Rouge (USA)). 1977. Contract EY-76-S-05-4699. 27p. Dep. NTIS, PC A03/MF A01.

Progress is reported for research on the frequency with which nucleons within a parent nucleus coalesce into clusters. Results of recent data using $^{6}Li + Tl$ are shown for a beam energy of 2.2 GeV/N. Intensity aspects of the data are discussed. (SDF)

NUCLEAR PROPERTIES AND REACTIONS, A=220 AND ABOVE, EXPERIMENTAL

RADIOACTIVE DECAY

REFER ALSO TO CITATION(S) 34100

34094 (UCRL—78978) **Half-life of ^{239}Pu as determined by pulse-counting mass spectrometry.** Prindle, A.L.; Evans, J.E.; Newbury, R.S.; Dupzyk, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Jul 1977. Contract W-7405-ENG-48. 3p. (CONF-770575—4). Dep. NTIS, PC A02/MF A01.

From 25. annual conference on mass spectrometry and allied topics; Washington, DC, USA (29 May 1977).

The half-life of ^{239}Pu was measured by determining the ingrowth of ^{235}U during a known time by isotope dilution mass spectrometry techniques.

ENERGY LEVELS AND TRANSITIONS

34095 (COO—3496-65, pp 22-49) **Influence of form factors and multistep effects on the ^{232}Th(d,t) ^{231}Th and ^{230}Th(d,p) ^{231}Th reactions.** Wilcke, W.; Felix, W.; Elze, Th.W.; Huizenga, J.R.; Thompson, R.C.; Dreisler, R.M. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

Tables of spectroscopic information are given for the nuclei ^{233,235,237}Pa, and ^{229,231}Ac studied in the reactions ^{234,236,238}U, and ^{230,232}Th(t,α), including spin, parity, differential cross sections, and spectra. These quantities are discussed and plotted. (JFP)

34096 (COO—3496-65, pp 50-62) **Levels of ^{235}Np excited by the ^{234}U(^{3}He,d) and ^{234}U(α,t) reactions.** Griffioen, R.D. (Calvin Coll., Grand Rapids, MI); Thompson, R.C.; Huizenga, J.R. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

The results of measurements of proton states in ^{235}Np excited by the ^{234}U(^{3}He,d) and (α,t) reactions are reported. Spins, parities, spectra, differential cross sections, and excitation energies are found. The bombarding energy was 30 MeV. 17 references. (JFP)

NUCLEAR REACTIONS AND SCATTERING

REFER ALSO TO CITATION(S) 34095, 34096

34097 (COO—3496-65, pp 168-177) **Total muon-capture rates in ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu by electron measurements.** Johnson, M.W.; Schroeder, W.U.; Huizenga, J.R.; Hensley, W.K.; Perry, D.G.; Browne, J.C. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

An accurate determination is given for muon-capture rates by a measurement of the electrons from the decay of muons in the 1s orbit of muonic ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu. Also the ratio of capture rates is evaluated with a deformed and spherical nuclear potential. 10 references. (JFP)

34098 (DP-MS—77-44) **Neutron total cross section measurements for ^{249}Bk and ^{249}Cf.** Benjamin, R.W.; Harvey, J.A.; Hill, N.W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.; Oak Ridge National Lab., Tenn. (USA)). 1977. Contract EY-76-C-09-0001. 19p. (CONF-771109—92). NTIS, MF A01.

From ANS winter meeting; San Francisco, CA, USA (27 Nov 1977).

Portions of document are illegible.

Total neutron cross sections have been measured for ^{249}Bk and its β decay daughter, ^{249}Cf. Single level Breit-Wigner resonance analysis has been performed for 35 resonances below 62 eV in Bk and for 10 resonances below 10 eV in Cf. (SDF)

34099 (ORNL/TM—6161) **Evaluation of the ^{232}Th neutron capture cross section above 3 keV.** de Saussure, G.; Macklin, R.L. (Oak Ridge National Lab., Tenn. (USA)). Dec 1977. Contract W-7405-ENG-26. 52p. Dep. NTIS, PC A04/MF A01.

This memo describes an evaluation of the ^{232}Th neutron capture cross section in the neutron energy range from 3 keV to 20 MeV. Most existing differential measurements are reviewed, and some data are renormalized to current values of the standards. Several experimentally determined sets of average resonance parameters are also discussed. From 3 to 50 keV the evaluated cross section is described by a set of average statistical resonance parameters. Above 50 keV the evaluated capture cross section is a smooth curve which follows the trend of the most recent measurements. The evaluated capture cross section is compared with many measurements and uncertainty estimates are given.

SPONTANEOUS AND INDUCED FISSION

34100 (ANL/NDM—38) **Alpha and spontaneous fission half-lives of ^{242}Pu.** Meadows, J.W. (Argonne National Lab., Ill. (USA)). Dec 1977. Contract W-31-109-ENG-38. 16p. Dep. NTIS, PC A02/MF A01.

The alpha and spontaneous fission half-lives of ^{242}Pu are measured relative to the alpha half-life of ^{239}Pu. If the alpha half-life of ^{239}Pu is 24290 +- 70 y, the ^{242}Pu alpha half-life is (3.736 +- .029) x 10^{5} y and the spontaneous fission half-life is (6.79 +- .04) x 10^{10} y.

34101 (LA-UR—77-2916) **Neutron multiplicity measurements of Cf and Fm isotopes.** Hoffman, D.C.; Ford, G.P.; Balagna, J.P.; Veeser, L.R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1977. Contract W-7405-ENG-36. 21p. (CONF-771225—1). Dep. NTIS, PC A02/MF A01.

From Conference on interactions of heavy ions with nuclei and synthesis of new elements; Dubna, USSR (13 Dec 1977).

Prompt neutrons in coincidence with the two fission fragments from the SF of californium 250, 252, and 254, and fermium 256 and 257 were measured with a 75-cm-diameter, Gd-loaded liquid scintillation counter having a neutron-detection efficiency of about 80%. The kinetic energies of both fission fragments and the number of neutrons for each fission event were recorded. From these data, the fragment masses and kinetic energies, the average number of neutrons per fission, and the neutron multiplicity distributions and their variances as a function of total fragment kinetic energy and the ratio of fragment masses have been calculated and will be presented.

NUCLEAR THEORY

34102 (ORO—5126-30) **Independent particle Schroedinger Fluid: moments of inertia.** Kan, K.K.; Griffin, J.J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1977. Contract EY-76-S-05-5126. 104p. Dep. NTIS, PC A06/MF A01.

This philosophy of the Single Particle Schroedinger Fluid, especially as regards the velocity fields which find such a natural role therein, is applied to the study of the moments of inertia of independent Fermion system. It is shown that three simplified systems exhibit the rigid-body rotational velocity field in the limit of large A, and that the leading deviations, both on the average and fluctuating, from this large A limit can be described analytically, and verified numerically. For a single particle in a Hill-Wheeler box the moments are studied numerically, and their large fluctuations identified with the specific energy level degeneracies of its parallelepiped shape. The full assemblage of these new and old results is addressed to the question of the necessary and sufficient condition that the moment have the rigid value. Counterexamples are utilized to reject some conditions, and the conjecture is argued that Unconstrained Shape Equilibrium might be the necessary and sufficient condition. The spheroidal square well problem is identified as a promising test case.

NUCLEAR REACTIONS AND SCATTERING

34103 (COO—3496-65, pp 63-74) **Internuclear potentials from heavy ion fusion excitation functions.** Birkelund, J.R.; Huizenga, J.R. Aug 1977.

In Studies of heavy ion reactions and transuranic nuclei. Progress report, June 1, 1976—August 31, 1977.

A discussion is given of the determination of internuclear potentials from heavy ion fusion excitation functions. It is found that this calculation is complicated by the difficulties involved in a calculation of the frictional energy loss and by the problem of measurement of excitation function with sufficient accuracy to closely define the barrier radius. Any quantitative comparisons made between the nuclear potential derived from fusion data and theoretical nuclear potentials depend upon the solutions of the above problems. 15 references. (JFP)

34104 (ORNL/TM—5850) **Effect of the energy dependence of the neutron widths on the calculation of average reaction cross sections.** Difilippo, F.C.; Perez, R.B. (Oak Ridge National Lab., Tenn.

(USA)). Dec 1977. Contract W-7405-ENG-26. 20p. Dep. NTIS, PC A02/MF A01.

The validity of neglecting the energy dependence of the neutron width in the calculation of average reaction cross sections is studied.

34105 (UCRL—50400(Vol.5)(Pt.B)) **Integrated system for production of neutronics and photonics calculational constants. Volume 5, Part B. Relativistic transformations between center-of-mass and laboratory systems for two-body nuclear reactions.** Howerton, R.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Jan 1978. Contract W-7405-ENG-48. 19p. Dep. NTIS, PC A02/MF A01.

A technique is described for transforming cross sections and secondary-particle energies between center-of-mass and laboratory systems for two-body nuclear reactions. The derivations of the relativistic transformations needed for this technique are also reviewed.

RADIATION AND SHIELDING PHYSICS

RADIATION PHYSICS

REFER ALSO TO CITATION(S) 34116

34106 (ORNL/TM—6132) **Calculated hadronic transmission through iron absorbers.** Gabriel, T.A.; Bishop, B.L. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 45p. Dep. NTIS, PC A03/MF A01.

The transmission of hadrons through iron absorbers is investigated for a variety of experimental configurations, and incident particle types (protons, and charged pions) and energies (0.8 GeV/c to 100 GeV). The results obtained are consistent with available experimental data.

SHIELDING CALCULATIONS AND EXPERIMENTS

34107 (CONF-780119—1) **Some new insights into collimator design.** Metz, C.E.; Atkins, F.B.; Tsui, B.M.W.; Beck, R.N. (Chicago Univ., Ill. (USA). Dept. of Radiology; Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1978. Contract EY-76-C-02-0069. 13p. Dep. NTIS, PC A02/MF A01.

From 13. symposium on radioactive isotopes in clinical practice and research; Badgastein, Austria (9 Jan 1978).

Portions of document are illegible.

Relationships among collimator design parameters, physical properties of the resulting images, and human observer performance are discussed. The insight provided by these relationships hopefully will prove useful to the individual who must design or select a collimator for a particular imaging task. (GHT)

NEUTRON INTERACTIONS WITH MATTER

34108 (AD—045002) **A machine-language computer program to obtain a neutron spectrum from a proton-recoil spectrum. Technical memo.** Heimbach, C.R. (Harry Diamond Labs., Washington, D.C. (USA)). Sep 1977. 27p. (HDL-TM—77-18). NTIS PC A03/MF A01.

An assembly-language computer program has been written for an ND812 minicomputer. The program allows rapid analysis of proton-recoil data by calculation of the neutron flux directly on the minicomputer. An oscilloscope displays the results. The data may then be examined without their being transferred to an external computer.

34109 (COO—2458-18) **Multigroup formalism for evaluation of continuous slowing down theory parameters.** Parvez, A.; Becker, M. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA). Dept. of Nuclear Engineering). 1975. Contract EY-76-S-02-2458. 19p. Dep. NTIS, PC A02/MF A01.

Continuous slowing down theory calculations have been found to yield significant discrepancies in the presence of strong absorption. An algorithm has been formulated for evaluating continuous slowing down theory parameters which should be applicable for cases with strong absorption. Excellent agreement with more precise calculations is obtained when the new parameters are used.

34110 (COO—2708/14-1) **Neutron research on condensed matter: a study of the facilities and scientific opportunities in the United States.** (National Academy of Sciences, Washington, D.C. (USA)). 1977. Contract EY-76-C-02-2708-014. 165p. Dep. NTIS, PC A08/MF A01.

An in-depth review of the present status and future potential of the applications of low-energy neutron scattering to research in the condensed-matter sciences, including physics, chemistry, biology, and metallurgy is presented. The study shows that neutron scattering technology has proven to be of enormous importance to research in the above areas and especially to those of solid-state physics and chemistry. The main emphasis is on the scattering of low-energy neutrons by condensed matter. Since the same type of neutron source facilities can be used for the study of radiation damage, this related topic has also been included. (GHT)

34111 (IEA—414) **Neutron transport in two dissimilar media anisotropic scattering.** Burkart, A.R.; Ishiguro, Y.; Siewert, C.E. (Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Engenharia Nuclear). Apr 1976. 9p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The elementary solution of the one-speed neutron-transport equation with linearly anisotropic scattering are used in conjunction with Chandrasekhar's invariance principles to solve in a concise manner the Milne problem for two adjoining half-spaces and the critical reactor problem for a reflected slab.

34112 (ORNL—5376) **Code PERTUBAT for processing neutron diffusion theory neutronics results for perturbation analyses.** Vondy, D.R.; Fowler, T.B. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 88p. Dep. NTIS, PC A05/MF A01.

This report documents a code which is used for perturbation analyses. The PERTUBAT code is a module in the local computation system which contains the VENTURE neutronics code for applying multigroup diffusion theory. First order effects are calculated for changes in macroscopic cross sections. These may be due to changes in nuclide densities and microscopic cross sections. A fractional change may be made in macroscopic cross sections or the effects of temperature changes may be accounted for directly given the temperature distributions and associated cross section data. Regular, adjoint flux integrals are made available for other use. These integrals and the perturbations may be obtained for selected conditions with multiple sets of the reference data files available in the run of the modular code system. Thus the regular flux may be generated for a reference state, the adjoint flux for a specific perturbed state, and the individual components to the net reactivity change may be obtained for the change between the two states in this computation system. Nuclide importance data may be obtained.

34113 (WAPD-TM—1365) **Spatial distribution measurements of fission neutrons in water as an oxygen data test (AWBA development program).** Green, L.; Ullo, J.J. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Feb 1978. Contract EY-76-C-11-0014. 49p. Dep. NTIS, PC A03/MF A01.

The spatial distribution of the total neutron density from a ^{252}Cf source in pure water was measured to high statistical precision at distances from 11 to 80 cm from the source. Assuming the adequacy of the ENDF/B-IV hydrogen, and reasonable constraints on the fission spectrum mean energy, good agreement between experiment and a one-dimensional transport calculation was obtained for both ENDF/B-III and IV oxygen, with Version III slightly better. However, small residual differences remained that could not be removed by adjustment of the spectrum mean energy alone.

MEDICAL PHYSICS

DOSIMETRY

34114 **Biophysical studies with high-energy argon ions. I. Depth dose measurements in tissue-equivalent liquid and in water.** Goodman; L.J.; Colvett, R.D. (Columbia Univ., New York). *Radiat. Res.;* **70**: No. 3, 455-468(Jun 1977).

The beam of high-energy argon ions available at the Lawrence Berkeley Laboratory BEVALAC was employed for biophysical experimentation. In preparation for radiobiological studies, depth doses were measured with a homogeneous tissue-equivalent ionization chamber which traversed the central axis of a tissue-equivalent liquid phantom irradiated by a large, uniform beam of ions. Ancillary measurements showed that for this beam: the depth dose profiles measured in a water phantom and in a tissue-equivalent liquid phantom are essentially the same, provide that the difference in the electron densities of the liquids is taken into account; the depth dose profile measured behind a water absorber is essentially the same as that measured within a water phantom; and reliable dosimetry for tissue can be performed using air instead of tissue-equivalent gas in the cavity of a tissue-equivalent plastic ionization chamber. Biological results are reported in succeeding papers.

34115 **Microdosimetry of internal sources.** Roesch, W.C. (Pacific Northwest Lab., Richland, WA). *Radiat. Res.;* **70**: No. 3, 494-510(Jun 1977).

Microdosimetry has been limited to irradiations characterized by uniform probabilities of charged-particle production. New methods are presented here for dealing with particles emitted by radionuclides embedded in the irradiated medium; these particles seldom emerge uniformly, because the radionuclides are not dispersed uniformly. In particular, emission from radionuclides that are agglomer-

ated into particulates is extremely nonuniform. Microdosimetric distributions for these internal emitters can be calculated by: (1) determining the probability density in specific energy due to single energy deposition events by charged particles from a point source, (2) combining these densities by Fourier-transform methods, and (3) using existing numerical methods to evaluate the Fourier result. Examples are given calculated for ^{239}Pu α particles from point sources (particulates) and from particulates uniformly distributed through all space, a half space, and a sphere.

34116 Radial dose, LET, and W-bar for ^{16}O ions in N_2 and tissue-equivalent gases. Varma, M.N.; Baum, J.W.; Kuehner, A.V. (Brookhaven National Lab., Upton, NY). *Radiat. Res.;* **70**: No. 3, 511-518(Jun 1977).

Average energy to produce an ion pair (anti W), distance restricted, and total linear energy transfer and dose as a function of radial distance D(r) from the ion's path were measured for 41.1-MeV ^{16}O ions in nitrogen and Rossi-type tissue-equivalent gas. Results for anti W were 38.9 +- 0.54 eV/ion pair for nitrogen and 33.4 +- 0.47 eV/ion pair for tissue-equivalent gas. Results for total linear energy transfer (LET/sub infinity/) were 6507 MeV . $cm^2\ g^{-1}$ for tissue-equivalent gas and 6210 MeV . $cm^2\ g^{-1}$ for nitrogen. Results for D(r) were used to calculate similar values to be expected in tissue-like material having a density of 1 g/cm^3. The range of radial distances covered was from 0.2 to 300 nm in tissue. Results are compared with calculations based on Paretzke's continuous slowing down model. Measured D(r) values in nitrogen were randomly distributed about the calculated values between radial distances of 0.56 and 286 nm. The mean deviation between the experimental and the calculated value was 1.3% (the experimental value being higher). For tissue-equivalent gas, previously measured D(r) values were also randomly distributed about the calculated values, with a mean deviation of 4% (the experimental value being lower) between radial distances of 1.5 and 140 nm.

34117 Depth-related differences in bone marrow cell inactivation with ^{60}Co γ rays. Carlson, D.E.; Thornton, J. (Univ. of Texas Health Science Center, Dallas). *Radiat. Res.;* **70**: No. 3, 564-574(Jun 1977).

Cell survival was compared to physical radiation doses at different depths in a tissue equivalent phantom. Mouse hematopoietic stem cells irradiated at 3-mm depth increments were assayed by spleen colony formation. Maximum energy deposition for ^{60}Co γ rays occurred at 0.5 cm below the surface followed by exponential attenuation with depth. In contrast, the maximum stem cell inactivation was approximately 2 cm below the surface. This phenomenon is independent of source distance and field size and suggests that changes in beam composition may be reflected in differential survival over the proximal few centimeters of depth.

SOLID STATE PHYSICS

REFER ALSO TO CITATION(S) 33419

SUPERCONDUCTIVITY

GENERAL THEORY

REFER ALSO TO CITATION(S) 33430

ACOUSTIC, ELECTRIC, MAGNETIC, OPTICAL, AND THERMAL PHENOMENA

REFER ALSO TO CITATION(S) 33406, 33410, 33420, 33422, 33429, 33471, 33529

34118 (ORO—4311-5) **Quantitative analysis of solute segregation in alloys by transmission electron microscopy. Progress report, January 1, 1977—December 31, 1977.** Hren, J.J.; Hartley, C.S. (Florida Univ., Gainesville (USA)). Feb 1978. Contract EY-76-S-05-4311. 52p. Dep. NTIS, PC A04/MF A01.

This report describes the results of a computer simulation of images for the FCC and BCC infinitesimal loops using isotropic elasticity. Partial experimental verification of the predictions of our catalog are reported for small loops in Al and W, the latter using data supplied by W. Jager of Argonne National Laboratory. Where possible, generalizations about the expected contrast for small loops in other real materials are included. Comparisons of the results with existing contrast rules (anti g . anti b and anti l analyses) are described at some length. The first results of the effect of including the displacement field for a finite loop in the isotropic approximation are also described. Further image calculations are required before generalizations can be made, but the initial results verify that the infinitesimal loop approximation describes the major image features extremely well.

THEORETICAL PHYSICS

STATISTICAL PHYSICS AND THERMODYNAMICS

34119 Asymptotic form of partition functions of linear chain molecules: an application of renewal theory. Beyer, W.A.; DeLisi, C. (Los Alamos Scientific Lab., NM). *J. Math. Anal. Appl.;* **57**: No. 2, 416-428(Feb 1977).

The statistical theory of linear chain molecules often has rational functions of a few analytic functions as the form of the generating function for the partition function Z/sup (n)/ of the linear chain molecule, n units long. For applications, it is necessary to know the limiting forms of Z/sup n/ as n → infinity. Renewal theory from probability theory is applied to determine this limiting form in important cases.

FUSION ENERGY

34120 (IAEA—199, pp 455-468) **Present status of activities in compilation and acquisition of atomic and molecular data for fusion in Japan.** Suzuki, H. (Jochi Univ., Tokyo (Japan)). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This is to report on the status of current and projected activities in compilation and dissemination of atomic and molecular data in Japan and to survey the domestic research activities in the related fields which enable Japan to acquire data for fusion research. A few examples of data needs are mentioned in connection with large scale plasma devices.

34121 (KFTI—75-29) **Bibliography on the stochastic processes in plasma and related problems. (1501-2000 items). No. 4.** Polovin, R.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1975. 36p. (In Russian, English). Dep. NTIS (US Sales Only), PC A03/MF A01.

Stochastic processes in plasma and related matters. The bibliography contains 500 references and was compiled from the open literature only. Some references are annotated or completed with short abstracts. There are subject and authors indexes.

34122 (KFTI—76-1) **Bibliography on the stochastic processes in plasma and related problems. (2001-2500 items). No 5.** Polovin, R.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1976. 36p. (In Russian, English). Dep. NTIS (US Sales Only), PC A03/MF A01.

Stochastic processes in plasma and related matters. The bibliography contains 500 references and was compiled from the open literature only. Some references are annotated or completed with short abstracts. There are subject and authors indexes.

34123 (KFTI—76-28) **Bibliography on the stochastic processes in plasma and related problems. (2501-3000 items). No. 6.** Polovin, R.V. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1976. 37p. (In Russian, English). Dep. NTIS (US Sales Only), PC A03/MF A01.

Stochastic processes in plasma and related matters. The bibliography contains 500 references and was compiled from the open literature only. Some references are annotated or completed with short abstracts. There are subject and authors indexes.

PLASMA RESEARCH

PLASMA CONFINEMENT AND HEATING

34124 (EUR-CEA-FC—911) **RF trapping of low energy ions in a mirror machine.** Melin, G. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1977. 20p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Wave launching with high nsub(parall) values near the ion cyclotron frequency is examined as a possibility to trap the low energy ions expelled by the ambipolar potential in a mirror machine. In the single particle approximation trapping effect is considered. Then some considerations about RF propagation and launching system are reported.

34125 (GA-A—14727) **Empirical scaling laws for energy confinement in ohmically-heated tokamaks.** Pfeiffer, W.W.; Waltz, R.E. (General Atomic Co., San Diego, Calif. (USA)). Jan 1978. Contract EY-76-C-03-0167-038. 59p. Dep. NTIS, PC A04/MF A01.

The interpretation and empirical determination of scaling laws for tokamak energy confinement are discussed. Special emphasis is given to the difficulty in determining the temperature dependence of the confinement time from ohmically-heated data. A large collection of ohmically-heated data is then presented. These data are analyzed statistically to obtain a temperature scaling and various confinement time scalings. Finally, the results are compared to previously proposed scalings.

34126 (KFTI—74-36, pp 22-27) **Anomalous electrical conductivity and turbulent heating of plasma in closed magnetic traps.** Dikii, A.G.; Pavlichenko, O.S.; Perepelkin, N.F.; Suprunenko, V.A. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. (In Russian).

In Nuclear science and engineering problems.

The behaviour of a turbulent current-carrying plasma in a closed magnetic trap was studied. A phenomenological analysis is presented which can be used to clarify the observable features of quasi-stationary turbulent heating of plasma on an anomalous ion-noise resistance in the Uragan-IM stellarator. The thresholds of disruption of ion noise (critical current) were determined theoretically and observed experimentally for the pseudo-classical law of energy loss in quasi-stationary turbulent heating of plasma in a torus. The transfer of electrons in a continuous accelerator regime was combined with this factor.

34127 (KFTI—74-36, pp 16-21) **Electron thermal conduction of current-carrying plasma in stellarators.** Vyurshing, E.; Pakher, G.; Renner, G.; Ringler, G.; Khaker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)); Dikii, A.G.; Pavlichenko, O.S.; Suprunenko, V.A.; Tonkopryad, V.M. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. (In Russian).

In Nuclear science and engineering problems.

Thermoinsulation of plasma during current heating in the Uragan-I and Wendelstein-III stellarators was studied experimentally. It was shown that energy loss across the stellarator magnetic field occurs along the electron channel and that electron heat conduction significantly increases the value predicted by neo-classical theory. Analysis of experiments made on the two stellarators showed that electron heat conduction by the current-carrying plasma in the stellarator is well described by the pseudo-classical formula of L.A. Artsimovich.

34128 (NRL-MR—3583) **Absorption and transformation of electromagnetic waves in the vicinity of electron cyclotron harmonics.** Antonsen, T.M. Jr.; Manheimer, W.M. (Naval Research Lab., Washington, D.C. (USA)). Nov 1977. Contract EX-76-A-34-1006. 35p. Dep. NTIS, PC A03/MF A01.

The recent development of multikilowatt millimeter wave sources has motivated the study of electron cyclotron heating of tokamaks. The direct absorption of the ordinary and extraordinary modes at the first and second harmonics of the electron cyclotron frequency are examined. For K.B = O WKB theory is inapplicable and a full wave treatment is necessary to determine transmission, absorption, reflection and mode conversion coefficients. The ordinary wave is efficiently absorbed at the first harmonic. The extraordinary wave is efficiently absorbed at the second harmonic due to mode conversion of the incident wave to a highly damped electrostatic wave.

34129 Direct determination of the electron energy confinement time of a tokamak plasma. Fisher, A.S.; Bekefi, G. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). *Phys. Lett., A;* **63**: No. 3, 281-284(14 Nov 1977).

A method of determining the electron energy confinement time tausub(E) is presented which does not require the absolute electron temperatures and densities, or their spatial profiles. A short heating pulse is applied to the plasma; the subsequent decay of electron temperature yields tausub(E).

34130 Enhanced heating of mirror-trapped ions under an instability around ion-cyclotron frequency. Hatakeyama, R.; Sato, N.; Sugai, H.; Hatta, Y. (Tohoku Univ., Sendai (Japan)). *Phys. Lett., A;* **63**: No. 1, 28-30(17 Oct 1977).

The high-energy tail of the ion energy distribution is heated by an instability with broad-band frequency spectrum having a peak a little above the ion-cyclotron frequency. The tail heating of the ions is enhanced under a mirror configuration of the magnetic field.

34131 Axial heating of magnetically confined plasma with CO_2 lasers. Offenberger, A.A. (UKAEA Research Group, Abingdon. Culham Lab.). *Can. J. Phys.;* **55**: No. 5, 412-418(1 Mar 1977).

The coupled electron-ion heating equations, neglecting losses, in a CO_2 laser heated solenoid are solved for a laser intensity varying with time. An analytical solution, without restriction on the ratio of electron-to-ion temperatures is found. The heating wave which propagates along the solenoid is found to be supersonic having a velocity independent of time. Low intensity heating is found to maximize Tsub(i)/Tsub(e) and minimize plasma length and laser energy requirements. The heating wave propagation is found to be consistent with an optical thickness of order unity in the heated plasma column. Considerations of electron-ion energy transfer, supersonic heating wave propagation, and laser beam trapping lead to an optimum laser intensity parameter I_0 approximately equal to 2 x 10^{13} W cm^{-2}ssup(-2/3).

34132 Ohmic plasma heating in the L-2 stellarator. Akulina, D.K.; Andryukhina, E.D.; Berezhetskii, M.S. (AN SSSR, Moscow. Fizicheskij Inst.) (and others). pp 115-126 of Plasma physics and controlled nuclear fusion research 1976. Proceedings of the 6. international conference held by the IAEA at Berchtesgaden, 6-13 October 1976. Vol. 2. Vienna; IAEA (1977).

From 6. international conference on plasma physics and controlled nuclear fusion research; Berchtesgaden, F.R. Germany (6 Oct 1976).

See CONF-761012—.

The paper gives the results of the first experiments on the L-2 stellarator, put into operation at the end of 1975. The L-2 stellarator consists of a toroidal magnetic trap with a double (l=2) helical field. The major diameter of the torus D=200 cm, and the cross-sectional diameter of the vacuum chamber d=35 cm. The maximum magnetic field B_0=20 kG (in the experiments under consideration, B_0<=14 kG). The rotational transform angle on the axis rotational transformsub(delta)(0)=0.2, on the boundary surface rotational transformsub(delta)(a)=0.7, and the shear theta approximately equal to 0.5. The mean radius of the boundary magnetic surface a bar=11.5 cm. The limiting gas-kinetic plasma pressure for B_0=20 kG, determined from stability and equilibrium conditions, is 10^{17} eV cm^{-3}. Ohmic heating of the plasma was used in the first stage of the studies. At a current I approximately equal to 20 kA, a plasma with density n barsub(e) approximately equal to 10^{13} cm^{-3} was obtained, with a mean electron temperature T barsub(e) approximately equal to 300 eV and an effective charge Zsub(eff) approximately 3. The energy life-time of the plasma tausub(E) approximately equal to 6-8 ms approximately equal to $3.6x10^{-8}a^2B$ perpendicular, where B perpendicular = (Bsub(S)+Bsub(I)) perpendicular; (Bsub(S)) perpendicular is the average transversal stellarator field, (Bsub(I)) perpendicular is the current poloidal field. The relationship with the Bohm time tausub(Bohm) can be written tausub(E) approximately equal to (40-50) tausub(Bohm). At a current reaching a certain critical value Isub(cr)=2.5 B_0 (a/g), corresponding to the total angle of rotational transform on the axis of rotational transformsub(Σ)(0) approximately equal to 1, the appearance of helical perturbations with n/m=1/1, limiting the magnitude of the plasma current, was observed.

PLASMA DIAGNOSTICS

34133 (CEA-CONF—3868) **Acquisition system for the diagnostics data from a toroidal machine.** Moulin, B. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). 1976. 5p. (In French). (CONF-761232—11). Dep. NTIS (US Sales Only), PC A02/MF A01.

From National congress on plasma physics; Paris, France (6 Dec 1976).

The data acquisition system 'ARIANE' has been conceived by the SIG (Service d'Ionique Generale), for physical measurements on the toroidal machines PETULA and WEGA, which were designed to study the H.F. heating of pulsed plasmas. These systems are constitued of electronic modules which permit them to be adapted to different kinds of measurements, either by analogue channels or by pulse counting. The programmation of these systems, are achieved, either by multiswitches accessible manually on front panels, or by a computer which performs the numerical computations.

34134 (EUR-CEA-FC—898) **Small dimensions, continuous submillimeter lasers HCN (lambda=337μ) and DCN (lambda=195;190μ).** Bruneau, J.L. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee; Orleans Univ., 45 (France)). Jun 1977. 116p. (In French). Dep. NTIS (US Sales Only), PC A06/MF A01.

Thesis.

The development of waveguide HCN lasers (337μ) for TFR plasma entailed an increase in their power density. The scaling laws show that a 0.5 meter long discharge would be able to deliver a few mW (3mW have been already extracted). At the other end of the scaling laws, the 'one Watt' laser could be shortened by using a rectangular cross section instead of the circular one. The increase in the electron density provided for new Tokamaks makes suitable the use of a DCN laser with shorter wavelength emission (190, 195μ). The optimal working conditions for this laser were determined from the scaling laws of the HCN laser.

34135 (IAE—2484) **Spectroscopic study on light element impurities in the Tokamak-6 plasma.** Notkin, G.E.; Shcheglov, D.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

The results are presented of spectroscopic studies of plasma with Tokamak-6 unit for the region of wavelengths 130-700 nm. A brief description is given of the equipment used. A so-called quasi-coronal model of populating the upper levels of the lines under investigation has been proposed for calculating the concentrations of (C5, N6, O7) ions. Proceeding from the absolute values of intensities of the ion lines studied and from the proposed model, the concentrations of these ions are evaluated. Some consequences of this model are verified by measuring the intensity ratios for the triplets under studies. The contribution of light elements into the effective plasma charge is estimated.

34136 (IAE—2583) **Electron temperature measuring in the Tokamak-6 device by means of laser radiation scattering.** Berlizov, A.B.; Notkin, G.E.; Sannikov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. 8p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A procedure has been developed for measuring the plasma electron temperature by the laser scattering method. Using a ruby laser measurements have been caried out in the center of a plasma filament in the Tokamak-6 facility at various discharge parameters. The experiment layout and the experimental results are given, which are in a good agreement with the results of diamagnetic measurements of the total plasma energy.

34137 (IAEA—199, pp 297-370) **Data needs, priorities and accuracies for plasma spectroscopy.** McWhirter, R.W.P. (Appleton Lab., Abingdon, UK). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion.

This paper presents the theory underlying plasma spectroscopy as it applies to both laboratory and astronomical sources. It is shown that the atomic data required to calculate the intensities of spectral lines from the plasma are primarily the excitation coefficients from the ground and metastable levels of the ion. Ionisation rate coefficients are the next most important class of atomic data. Two simpler methods are used to calculate those coefficients- the Seaton's empirical formula (SEF) and the Exchange Classical Impact Parameter (ECIP). Comparison of the calculations with experimental results (a sample of 17 different ions is used) favours the ECIP-method.

34138 (IPP—1/166) **Electro-optical frequency shifting of lasers for plasma diagnostics.** Forman, P.R. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Jul 1977. 20p. Dep. NTIS (US Sales Only), PC A03/MF A01.

An electro-optical frequency shifting device is proposed as an aid for plasma physics heterodyne interferometry and heterodyne scattering experiments. The method has the advantage over other electro-optic shifters, that a pure separable frequency shifted beam can be obtained even when less than half wave voltage is applied.

34139 (IPP—4/150) **Use of langmuir probes in a laser-produced plasma.** Chang, C.T. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Jan 1977. 27p. Dep. NTIS (US Sales Only), PC A03/MF A01.

It was found that in a plasma produced by irradiating a solid target with a laser beam Langmuir probes, besides their application for time-of-flight measurements, can be used to determine both the electron temperature Tsub(e) and the number density nsub(e) in the asymptotic expansion phase. In the immediate vicinity of the target successful application of the probe is doubtful. In the intermediate region, although the determination of Tsub(e) might be difficult, the electron number density nsub(e) can still be determined from the ion saturation current. Based on a repeated guess of the plasma potential, an iterative method was found for the determination of Tsub(e) to a better accuracy in the asymptotic expansion phase. Finally, a brief discussion of the use of probes in a magnetized plasma is given.

34140 (LA—7127-MS) **Simple measurement of line density.** Armstrong, W.T.; Siemon, R.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Feb 1978. Contract W-7405-ENG-36. 5p. Dep. NTIS, PC A02/MF A01.

Energy line density, E/sub l/ = $\int$(F/2)nk(T/sub e/ + T/sub i/)dA, has proved to be one of the easiest (and most critical) measurements made on the Scylla IV-P, 5-m linear theta pinch. A quantitative evaluation of end-stoppering techniques is made available by extracting the line energy containment time, tau/sub E/sub l//, from the time history of E/sub l/. To model E/sub l/(t) properly and, hence, determine the details of energy loss mechanisms (streaming and thermal conduction) requires separate measurements of n and T. A simple measurement of line density, n/sub l/ = $\int$ndA, is proposed, in which a single laser beam is passed repeatedly through the plasma column along different chords. A discussion is presented of the measurement accuracy as a function of the number of passes.

34141 (PPPL—1431) **Charge-exchange measurements of parallel and anti-parallel ion temperature profiles on ATC.** Goldston, R.J. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Mar 1978. Contract EY-76-C-02-3073. 29p. Dep. NTIS, PC A03/MF A01.

This paper describes measurements of the ion temperature profiles parallel and anti-parallel to the plasma current in the ATC tokamak. The measurements were made using a single energy channel multi-sight-line neutral particle detector. The anti-parallel profile was found to be parabolic or somewhat broader, in accordance with expectation, while the parallel profile was nearly flat from the plasma center to within a few centimeters of the edge. This difference between the two profiles is interpreted as being due to neoclassical effects associated with large banana orbits.

34142 (UCRL—79861) **X-ray lines as a density diagnostic in DT plasmas near 100x solid density.** Bailey, D.S. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1977. Contract W-7405-ENG-48. 12p. (CONF-771136—28). Dep. NTIS, PC A02/MF A01.

From Annual American Physical Society meeting; Atlanta, GA, USA (7 Nov 1977).

The use of electron impact broadened resonance lines to diagnose near-term high density diagnostics is discussed. In particular, the question of how to choose seed and pusher materials to have discernible broadening effects while maintaining line visibility is discussed.

34143 **Origin of Ksub(α) radiation in laser-produced aluminium plasma.** Zigler, A.; Zmora, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center); Schwob, J.L. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). *Phys. Lett., A;* **63**: No. 3, 275-278(14 Nov 1977).

The origin and mechanisms responsible for the appearance of Ksub(α) radiation in laser-produced Al plasma has been investigated employing space resolved X-ray spectroscopy and multilayered targets. It was concluded that this radiation is mainly generated by inner-shell ionization by suprathermal electrons.

34144 **Theory of electrostatic stagnation point probes in a low - density flowing continuum plasma. II. The effects of the Knudsen number.** Chang, J.S.; Kodera, K. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France)). *J. Phys., D (London);* **10**: No. 16, 2207-2212(11 Nov 1977).

The continuum stagnation point electrostatic probe theory by Kodera and Chang (J. Phys. D.; 9:2349(1976)) has been extended for a finite-charged-particle mean free path under continuum neutral flow conditions, i.e. those in which the gas particles mean free path $<$sphere radius, and charged particle mean free path $<$sphere radius $<$ Debye length. The numerical results show that: (1) an effective Knudsen number (for charged particle) smaller than 10^{-2} is required for continuum conditions; (2) the influence of effective Knudsen number increases with diffusion Reynolds number; (3) the influence of effective Knudsen number increases with retarding surface potentials and decreases with increasing attracting surface potential; (4) the usual retarding potential method for temperature determination will lead to an increasing overestimate of Tsub(e) as the effective Knudsen number decreases; (5) the effect of effective Knudsen number is to smooth the 'knee' of the probe characteristic and to render more imprecise the determination of space potential.

34145 **Pulsed spherical probe measurements of plasma conductivity in a flowing continuum plasma.** Clements, R.M.; Oliver, B.M. (Victoria Univ., British Columbia (Canada). Dept. of Physics); Smy, P.R. *J. Phys., D (London);* **10**: No. 16, 2213-2224(11 Nov 1977).

Measurements have been made of the electron conductivity in an atmospheric-pressure flowing plasma using a pulsed spherical probe. The method involves measuring the peak electron current flowing to the probe in response to a positive pulsed change in the probe potential. It is shown that for many circumstances the pulse technique effectively eliminates the very large potentials which are usually generated at plasma electrode interfaces during plasma resistance measurements.

34146 **Cooperative Thomson scattering from plasma with pulsed CO_2 laser radiation.** Pasternak, A.W.; Offenberger, A.A. (Alberta Univ., Edmonton (Canada). Dept. of Electrical Engineering). *Can. J. Phys.;* **55**: No. 5, 419-427(1 Mar 1977).

An experiment is described in which a 10-20 MW pulsed CO_2 laser is used to probe the thermal ion fluctuations in a magnetized argon arc plasma with Nsub(e) approximately equal to 2×10^{15} cm^{-3}, Tsub(e) approximately equal to 3.5 eV, and Tsub(i) approximately equal to 2 ev. Resolution of scattered ion spectra is achieved with a high finesse infrared Fabry-Perot interferometer. Scattered information is recovered through a multi-shot signal averaging technique

which yields a S/N factor of approximately 10 for $<\mu W$ scattered power levels. Results are compared with spectra calculated from a knowledge of plasma conditions and laser and instrumental linewidths. Demonstration of this diagnostic technique indicates that similar methods could be successfully applied to present magnetically confined fusion research plasmas.

34147 Time resolved x-ray photography of a dense plasma focus. Burnett, J.C.; Meyer, J.; Rankin, G. (British Columbia Univ., Vancouver (Canada). Dept. of Physics). *Can. J. Phys.;* **55**: No. 3, 194-197(1 Feb 1977).

The temporal development of the hot plasma in a dense plasma focus is studied by x-ray streak photography of approximately 2 ns resolution time. It is shown that initially a uniform x-ray emitting pinch plasma is formed which subsequently cools down until x-ray emission stops after approximately 50 ns. At a time of around 100 ns after initial x-ray emission coinciding with the breakup time of the pinch a second burst of x-rays is observed coming from small localized regions. The observations are compared with results obtained from time-resolved shadow and schlieren photography of a similar dense focus discharge.

34148 Measurement of the plasma electron temperature and density distribution in the TM-3 TOKAMAK by the laser radiation scattering technique. Sannikov, V.V. *Zh. Eksp. Teor. Fiz.;* **72**: No. 1, 119-126(1977). (In Russian).

13 refs.; 7 figs.; for English translation see the journal Sov. Phys. - JETP.

The temperature of 0.15 to 1.2 KeV electrons is measured by the Thomson scattering technique in the TM-3 Tokamak under stable discharge conditions at plasma densities nsub(e)=6×10^{12}-6×10^{13} cm^{-3}. The experimental procedure and electronic equipment used are shortly discussed. The radial distributions of electron temperature and density in the discharge column are obtained for various plasma parameters. For one of the standard regimes (Hsub(Z)=22 kOe, J=50kA and nsub(e)=6×10^{13} cm^{-3}) the time dependence of electron density and temperature is measured. The diamagnetic and laser measurements of electron temperature are compared, the discrepancies being pointed out to narrow with increase of electron density.

PLASMA KINETICS - GENERAL

34149 (IAEA—199, pp 483-487) **Atomic and molecular data for nuclear fusion in the USSR.** Abramov, V.A.; Martynenko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

Translated from Russian.

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This paper describes the actual state and the information needs on atomic and molecular data for nuclear fusion in the USSR.

34150 (IAEA—199, pp 3-11) **Report of the working group on international cooperation.** 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This paper gives a short description of the tasks which would be carried on by the IAEA Nuclear Data Section in the field of atomic and molecular data for fusion.

34151 (IAEA—199, pp 13-45) **Report of the working group on atomic collision data.** 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

In this report, rate coefficients for collisional excitation and ionization are seen as the most important A+M-data needs. Reference to specific groups and work is done to clarify the nature of the data needs. As final recommendation, the authors propose a scheme for making an appraisal of the resources available to attack the problems identified.

34152 (IAEA—199, pp 47-53) **Report of the working group on the requirements of atomic structure data.** 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

The status of atomic structure data with respect to the needs of Thermonuclear Fusion Research Programs is reported. Three topics are discussed: Data requirements and justifications, assessment of the existing data compilations and recommendations to the IAEA.

34153 (IAEA—199, pp 55-75) **Report of the working group on surface interaction data for fusion devices.** 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

In this paper the role of surfaces from the point of view of the effect of impurities of plasma recycling is considered. Equal importance is given to the erosion and radiation damage of the first wall. Both immediate and long term needs for the understanding of the first wall interactions are extensively discussed.

34154 (IAEA—199, pp 405-446) **National programmes on atomic and molecular data for fusion in France.** Delcroix, J.L. 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

Translated from French.

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

GAPHYOR (Gaz Physique Orsay) is a retrieval system of the single properties of atoms and molecules, of the interaction properties between these particles and the macroscopic properties of the corresponding gases. Qualities, difficulties and possible improvements are discussed.

34155 (IAEA—199, pp 81-113) **Role of atomic and molecular processes in fusion research.** Harrison, M.F.A. (Euratom-UKAEA Association for Fusion Research, Culham Lab., Abingdon, UK). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This paper considers the relevance of atomic and molecular processes to research into controlled nuclear fusion and in particular their effects upon the magnetically confined plasma in Tokamak experiments and conceptual Tokamak reactors. The relative significance of collective phenomena and of single particle collisions to both plasma heating and loss processes are discussed and the pertinent principles of plasma refuelling and plasma diagnostics are outlined. The methods by which atomic and molecular data are applied to these problems, the contributing effects of surface interactions and the consequent implications upon the accuracy and the type of data needed are described in a qualitative manner. Whilst particular atomic and molecular processes are not discussed in detail, sufficient information is given of the physical environments of Tokamak devices for significant processes to be self evident.

34156 (IAEA—199, pp 489-490) **Compilation and dissemination within the UK of atomic and molecular data relevant to fusion research.** Harrison, M.F.A. (Euratom-UKAEA Association for Fusion Research, Culham Lab., Abingdon, UK). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

34157 (IAEA—199, pp 519-533) **ERDA support for magnetic fusion-related atomic physics.** Martinez, J.V. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Physical Research); Stone, P. (Energy Research and Development Administration, Washington, D.C. (USA). Div. of Magnetic Fusion Energy). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This paper explains briefly the research in magnetic fusion-related atomic and molecular (A+M) physics supported by the US Energy Research and Development Administration (ERDA).

34158 (IAEA—199, pp 469-481) **Activities on atomic and molecular data for fusion in Japan Atomic Energy Research Institute.** Nakai, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

In this paper the present and future activities on Atomic and Molecular Data for Fusion carried out at JAERI are presented. Essentially: A+M research related to Tokamak devices, studies on plasma-wall interaction, Spectroscopic studies, Surface damage and Inner shell excitation of low atomic number materials by ion bombardments.

34159 (IAEA—199, pp 293-296) **Cross section data including atoms and ions in the highly excited Rydberg states.** Ohtani, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

34160 (IAEA—199, pp 371-375) **Techniques for the calculation of atomic data required for plasma diagnostics.** Saraph, H.E. (University Coll., London (UK). Dept. of Physics). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This report deals with computational techniques for the calculation of atomic data required for plasma diagnostics. The ranges of validity of the various techniques are discussed.

34161 (IAEA—199, pp 115-118) **Proposed IAEA programme on A+M data for fusion.** Schmidt, J.J.; Lorenz, A. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

After an outline of the major functions of the IAEA Nuclear Data Section (IAEA/NDS) as an international data centre a short description is given of the past development and future plans of the new IAEA/NDS programme on atomic and molecular (A+M) data for fusion. This programme is designed to coordinate the international cooperation in the assessment, determination, compilation and evaluation of A+M data and their dissemination to the scientific community concerned.

34162 (IAEA—199, pp 447-454) **National programmes and emphasis on A+M data for fusion in the Federal Republic of Germany.** Waelbroeck, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

Fusion research in the Federal Republic of Germany is centered on plasma confinement in toroidal devices. The effort is part of the Fusion Programme of the European Community. The A+M data acquisition activities are consequently strongly concentrated within but a few areas of this very broad field, with a strong emphasis on plasma-wall-interaction (Garching, Juelich, to some extent HMI, Berlin). Further activities on cluster acceleration (Karlsruhe), Lithium, Tritium equilibrium and kinetics (Juelich) and data compilation (Karlsruhe, Garching and Duesseldorf) also take place. Data on electron impact ionisation and excitation are the main programme of some university laboratories, and are also gathered, when the need arises, in the course of the confinement programme.

34163 (IAEA—199, pp 193-216) **Data needs, priorities and accuracies for plasma modelling.** Watkins, M.L. (Euratom-UKAEA Association for Fusion Research, Culham Lab., Abingdon, UK). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

To determine the needs, priorities and accuracies of the atomic and molecular physics data required for plasma modelling the role of these data in computer simulations of magnetically confined plasmas is reviewed. The models approximate atomic and molecular reactions in many different ways. Multi-dimensional calculations concerned with the equilibrium and stability of a plasma-magnetic field configuration assume the plasma to consist of fully ionised hydrogen ions and electrons in the magnetohydrodynamic approximation: the effect of atomic and molecular reactions is minimal. Zero (spatial) dimensional calculations of the break-down phase of gas discharges assume the gas to consist of atomic and molecular hydrogen electrons and impurity ions such as oxygen, carbon, iron, tungsten and molybdenum: the effect of plasma motion is minimal. Between these extremes are classes of computations such as the one (spatial) dimension transport calculations which attempt to establish a realistic balance between the behaviour of ions, atoms and molecules in an established discharge. The limitations and inadequacies of present data and models for atomic and molecular processes are illustrated by several specific calculations. The results of these calculations permit identification of the areas where improved models and data for the atomic and molecular reactions are required.

34164 (IAEA—199, pp 535-540) **Atomic data compilation and evaluation programs at NBS pertinent of fusion research.** Wiese, W.L. (National Bureau of Standards, Washington, D.C. (USA)). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

This paper describes the activities of the U.S. National Bureau of Standards in the field of Atomic Data Compilation and Evaluation Programs for Fusion. An overview of atomic structure data needs for magnetic fusion research is also given.

34165 (INIS-mf—3949) **Plasma physics research group annual progress report.** (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Dec 1976. 41p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Research conducted into: hydromagnetic waves, linear diffuse pinches, toroidal plasmas and hypersonic shock waves during 1976 is reviewed.

34166 (Rijnhuizen-ASR—1976) **Annual status report 31 December 1976.** (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Jul 1977. 90p. Dep. NTIS (US Sales Only), PC A05/MF A01.

The 1976 activities of the institute as related to fusion research are described in three sections. In the first section, the experimental division, work is reported on the long-term behavior of screw pinch plasmas in SPICA and the short-term behavior of the non-circular plasma is SP IV b. The second section, the theoretical division, describes the work done on magnetohydrodynamics of toroidal systems, on wave dynamics in inhomogeneous plasmas, transport phenomena in plasmas and on advanced fusion fuels. The third section, technology and engineering, summarizes the activities done in support of the experimental studies and the contribution of FOM members to the Joint European Torus project.

34167 (TRITA-EPP—77-23) **Plasma flow in a curved magnetic field.** Lindberg, L. (SEE ALSO- 6140550 Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Sep 1977. 27p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A beam of collisionless plasma is injected along a longitudinal magnetic field into a region of curved magnetic field. Two unpredicted phenomena are observed: The beam becomes deflected in the direction opposite to that in which the field is curved, and it contracts to a flat slab in the plane of curvature of the magnetic field. The phenomenon is of a general character and can be expected to occur in a very wide range of densities. The lower density limit is set by the condition for self-polarization, nm sub(i)/epsilon$_0$B^2 >> 1 or, which is equivalent, c^2/v^{2}sub(A) >> 1, where c is the velocity of light, and v sup(A) the Alfven velocity. The upper limit is presumably set by the requirement ωsub(e)tau(e) >> 1. The phenomenon is likely to be of importance e.g. for injection of plasma into magnetic bottles and in space and solar physics. The paper illustrates the comlexity of plasma flow phenomena and the importance of close contact between experimental and theoretical work.

PLASMA KINETICS - EXPERIMENTAL

34168 (EUR-CEA-FC—892) **Space-resolved vacuum ultra-violet spectroscopy on T.F.R. tokamak plasmas.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Equipe TFR). Apr 1977. 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The results of space-resolved vacuum-ultraviolet spectroscopy (between 100A and 2000A) on T.F.R. Tokamak plasmas are reported. Examples of profiles for both heavy and light impurity ions are given. Particular stress is put upon the experimental method and the associated uncertainties and problems. The great importance of numerical calculations in the interpretation of the impurity profiles is pointed out.

34169 (EUR-CEA-FC—904) **Experimental study of the profiles of the Hsub(β) and HeI 4^{3}D, ^{3}F-2^{3}P spectral lines broadened by Stark or Stark-Zeeman effect.** Ramette, J. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-

Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee; Paris-11 Univ., 91 - Orsay (France)). Jun 1977. 274p. (In French). Dep. NTIS (US Sales Only), PC A12/MF A01.

Thesis.

The profiles of the Hsub(β) (lambda=4861.32A) and HeI(lambda=4471.48A and lambda=4470.04A) lines emitted during the recombination phase of pulsed plasmas confined by magnetic fields (0<=B<=100kG) were measured using a ten-channel glass fiber analyzer. The following phenomena were observed: the effect of the atomic level fine structure on the spectral line width and on the spectral shift in the presence of a magnetic field, for low electron densities; plasma satellite lines resulting from the coupling of the luminous emission with longitudinal plasma waves self-excited during the recombination phase; the existence of a central component of the Hsub(β) line during the recombination phase (this phenomenon is attributed to the coupling between the luminous emission and longitudinal acoustic ion waves); the observation of the H_2 molecular spectrum during the recombination phase; a very strong coupling between Stark effect and Zeeman effect: consequently, the components of the normal Zeeman effect are shifted as the electron density increases.

34170 Tungsten radiation from tokamak produced plasmas. Isler, R.C.; Neidigh, R.V. (Oak Ridge National Lab., Tenn. (USA)); Cowan, R.D. (Los Alamos Scientific Lab., N.Mex. (USA)). *Phys. Lett., A;* **63**: No. 3, 295-297(14 Nov 1977).

Tungsten radiation from the Oak Ridge tokamak has been identified by comparing experimental results to calculated spectra for ions having open 4d subshells. The concentrations of tungsten are estimated from computed oscillator strengths to be of the order of 10^{-3}nsub(e).

34171 Measurement of electron temperature and density in radio-frequency discharges in air. Bhiday, M.R.; Kanitkar, P.L.; Deshmukh, S.V. (Poona Univ. (India). Dept. of Physics). pp 161-167 of Proceedings of the symposium on plasma physics and magnetohydrodynamics [held at] Bombay, February 5-6, 1975. Bombay; Department of Atomic Energy (1976).

From Symposium on plasma physics and magnetohydrodynamics; Trombay, Bombay, India (5 Feb 1975). See CONF-750266—.

Electron temperature Tsub(e) and electron density nsub(e) are measured in a radio-frequency discharge in dry air with internal plane parallel electrodes, using Johnson-Malter double probe technique. Electron temperature is found to remain constant when E/p varied from 150 to 250 Volts/cm. Torr. at frequencies 6,8 and 10 MHz. Under the identical conditions, electron density is found to increase almost exponentially with E/p at these frequencies. Electron temperature is found to increase slightly with frequency from 3 to 10 MHz, when measured at fixed value of E/p. Under present experimental conditions, electrons are found to follow Maxwellian energy distribution.

PLASMA KINETICS - THEORETICAL

34172 (EUR-CEA-FC—894) **Analysis of recent results of electron cyclotron emission measurements on T.F.R.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Equipe TFR). May 1977. 37p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Recently reported measurements of the electron cyclotron emission from the TFR Tokamak plasma are analyzed and compared to theoretical predictions. The line shape of an optically thick harmonic in a vertical observation is explained by wall reflections, plasma-detector arrangement and reabsorption. Non thermal emission at the electron plasma frequency is related to the presence of a high energy tail in the electron distribution function and might be the cause of the observed reduced runaway creation rate.

34173 (EUR-CEA-FC—909) **Numerical experiments on diffusion in toroidal plasmas.** Cissoko, G.; Papoular, R. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1977. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

This is a report of experiments performed with a sub-code of the Makokot code, including anomalous diffusion and discarding the coronal assumption for impurities. The computations give information on steady-state profiles, particle life times, relaxation time, behavior upon injection of matter and stability. The use of empirical diffusion laws is discussed.

34174 (IAE—2404) **Classical particle streams in plasma with one-dimensional density and temperature inhomogeneities.** Popryadukhin, A.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1974. 2p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

A problem of classic processes of transfer in thermonuclear synthesis was solved for the purpose of obtaining formulas describing the movement of impurities in a hydrogen or deuterium-tritium plasma. The study was not limited to examination of the case of a large mass ratio of the masses of the colliding particles. Inhomogeneity of the plasma at distances of the order of a Larmor radius is considered unidimensional and small, that is the local Maxwellians are in a zero approach of the dispersion function. By summation of the contributions of the colliding particles of type S with particles of the remaining types, expressions are obtained for the total stream of type S particles and for the rate of the ion and electron stream in a pure hydrogen plasma. In the study it was assumed that temperatures of all types of particles are the same. It is shown analytically that, while at constant temperature along the cross-section of plasma pinch impurities diffuse within the plasma, at a sufficiently high temperature gradient the diffusion rate is directed outward. Thus it is shown that impurities can be removed from the plasma volume.

34175 (IAEA—200, pp 185-202) **Non-linear processes in a dense plasma.** Samarskii, A.; Kurdyumov, S.P.; Zmitrenko, N.V.; Mikhailov, A.P. (AN SSSR, Moscow. Inst. Prikladnoj Matematiki). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

The paper presents the main results of the study of phenomena which accompany the development of strongly non-stationary processes (so-called peaking regimes) in a continuous medium whose description includes quasi-linear transfer equations.

34176 (IPP—6/161) **Cyclotron radiation from toroidal plasmas.** Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Jul 1977. 69p. Dep. NTIS (US Sales Only), PC A05/MF A01.

In this report cyclotron emission of a toroidal or cylindrical plasma is calculated on the assumption of MAXWELL-distributed electrons and KIRCHHOFF's law. The plasma density and temperature depend only on the distance r from the minor torus axis, wall reflectivity being taken into account. The radiation intensity at the plasma surface is computed numerically; some formulae interpolating the results are given. Furthermore, some spectra are presented in which the specific intensity is plotted versus the frequency.

34177 (IPPJ—261) **Landing of REB ring on equilibrium orbit.** Mohri, A.; Ikuta, K.; Masuzaki, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1976. 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

It is analytically shown that the decrease of the return current of plasma forces an injected relativistic electron beam to land on an equilibrium orbit inside a conductive toroidal chamber. The mechanism is similar to the adiabatic trapping of electrons in betatron.

34178 (IPPJ—263) **Trapping and detrapping in a single wave and particle acceleration in a magnetoplasma.** Sugihara, R.; Midzuno, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1976. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Particle motion within one bounce period $2\pi/\omega$ sub(B) is considered when the cyclotron frequency ω sub(C) is comparable with ω sub(B). The equation of motion with an approximation is solved analytically for certain initial values. The analytical solution thus obtained agrees quite well with numerically computed results over a wide range of ω sub(C) and ω sub(B). It is shown that under some conditions the particle is accelerated quite efficiently as compared with that in an unmagnetized plasma.

34179 (IPPJ—269) **Effects on nuclear fusion reaction on diffusion and thermal conduction in a magnetoplasma.** Sakai, K.; Aono, O. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 22p. Dep. NTIS (US Sales Only), PC A03/MF A01.

In spite of the well spread belief in the field of irreversible thermodynamics, vectorial phenomena couple thermodynamically with the scalar phenomena. Transport coefficients concerning the diffusion and the thermal conduction across a strong magnetic field are calculated in the presence of the deuteron-triton fusion reaction on the basis of the gas kinetic theory. When the reaction takes place, the diffusion increases and the thermal conduction decreases. Effects of the reaction exceed those of the Coulomb collision as the temperature is high enough.

34180 (IPPJ—270) **Helically symmetric equilibrium of current-carrying finite beta plasma.** Ohasa, K.; Hamada, Y.; Fujiwara, M.; Miyamoto, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 14p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Characteristics of helically symmetric equilibrium of longitudinal current-carrying finite beta plasma are studied analytically. Analytical expression of the rotational transform angle indicates that the contribution due to the helical component of the plasma current should be taken into account in addition to the rotational transform angle due to the external helical current and the longitudinal plasma current.

34181 (IPPJ—273) **Space and time evolution of two nonlinearly coupled variables. Special solutions.** Obayashi, H.; Totsuji, H.; Wil-

helmsson, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 22p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The system of two coupled linear differential equations are studied assuming that the coupling terms are proportional to the product of the dependent variables, representing e.g. intensities or populations. It is furthermore assumed that these variables experience different linear dissipation or growth. The derivations account for space as well as time dependence of the variables. It is found that certain particular solutions can be obtained to this system, whereas a full solution in space and time as an initial value problem is outside the scope of the present paper. The system has a nonlinear equilibrium solution for which the nonlinear coupling terms balance the terms of linear dissipation. The case of space and time evolution of a small perturbation of the nonlinear equilibrium state, given the initial one-dimensional spatial distribution of the perturbation, is also considered in some detail.

34182 (LA—7183-MS) **RIGGATRON nucleonics: one-dimensional analysis.** Wienke, B.R.; Dudziak, D.J.; Bosler, G.E. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 9p. Dep. NTIS, PC A02/MF A01.

Results of S/sub N/ and Monte Carlo one-dimensional neutron/gamma-ray transport calculations for conceptual designs of the INESCO RIGGATRON, a Tokamak device using ohmic heating to induce fusion, are detailed. Using various plasma, coil, and blanket configurations, a comparative analysis of cross-section sets is first performed. Scoping calculations of tritium breeding ratios, absorptions, leakages, and neutron/gamma-ray heating are detailed using both multigroup discrete-ordinates and Monte Carlo techniques. Results of this analysis not only serve to provide preliminary design parameters, but also indicate relative degree of consistency among various cross-section sets. Consistency between S/sub N/ and Monte Carlo techniques is similarly demonstrated. Results of this one-dimensional compilation also suggest a two-dimensional RIGGATRON model for related study.

34183 (PPPL—1428) **Interactive code for solving differential equations using phase integral methods.** White, R.B. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Mar 1978. Contract EY-76-C-02-3073. 36p. Dep. NTIS, PC A03/MF A01.

The solution of ordinary differential equations by the means of Phase Integral Methods is eminently suited for an interactive computational system with real time graphics. We describe a code devised for this purpose and illustrate its use.

34184 (RISO—365) **Strong turbulence in magnetized plasmas.** Tchen, C.M.; Pecseli, H.L.; Larsen, S.E. (Research Establishment Risoe, Roskilde (Denmark)). May 1977. 26p. Dep. NTIS (US Sales Only), PC A03/MF A01.

By means of a fluid description, an investigation is made of the spectral structure of turbulence in a plasma confined by a strong homogeneous magnetic field. The turbulent spectrum is divided into subranges. Mean gradients of velocity and density excite turbulent motions, and serve as sources in the production subrange. The spectra of velocity and potential fluctuations interact in the coupling subrange, and the energy is transferred along the spectrum in the inertia subrange, to be ultimately dissipated in a dissipation subrange. Applying the method of cascade decomposition, the authors obtain the spectral laws k^{-3}, k^{-3}, k^{-2} for the velocity fluctuations, and k^{-3}, k^{-5}, ksup(-3/2) for the potential fluctuations, in the production, coupling and inertia subranges, respectively. The Bohm diffusion coefficient is also reproduced. Good agreement is found with measured power laws reported in the literature.

34185 **Transport coefficients of the classical one-component plasma.** Bernu, B.; Vieillefosse, P.; Hansen, J.P. (Univ. Pierre et Marie Curie (France). Lab. de Physique Theorique des Liquides). *Phys. Lett., A;* **63**: No. 3, 301-303(14 Nov 1977).

Molecular dynamics computations of the thermal conductivity, and shear and bulk viscosities of the classical one component plasma in a rigid, uniform background are presented.

34186 **Theory of dense plasma afterglow.** Chang, J.S. (York Univ., Toronto, Ontario (Canada). Centre for Research in Experimental Space Science). *Phys. Lett., A;* **63**: No. 3, 304-306(14 Nov 1977).

An exact analytical theory has been developed for a volume recombination controlled afterglow under dense plasma conditions. The plasma transport properties may be determined by comparing experimental results with the present theory.

34187 **Schroedinger equation with exponential nonlinearity.** Sheerin, J.P. (Michigan Univ., Ann Arbor (USA). Dept. of Physics); Ong, R.S.B. (Michigan Univ., Ann Arbor (USA). Dept of Aerospace Engineering). *Phys. Lett., A;* **63**: No. 3, 279-280(14 Nov 1977).

The Schroedinger equation with exponential nonlinearity is solved in the time-independent case. The solutions are compared with those obtained from the case with cubic nonlinearity.

34188 **Constant in the Kruskal-Bernstein theory of runaway rates in plasmas.** Singh, N. (C.R.P.E., La Source, Orleans, France). *Phys. Lett., A;* **63**: No. 3, 307-308(14 Nov 1977).

Numerically obtained runaway rate is compared with that given by the Kruskal-Bernstein theory. The two rates compare well even for a relatively large electric field E if the constant C in the above theory is taken as C=0.3 + 0.75 E/Esub(D) where Esub(D) is the Drecier field.

34189 **Atomic physics algorithms for plasmas undergoing transient ionization and recombination.** Magill, J. (Glasgow Univ. (UK). Dept. of Natural Philosophy). *J. Phys., D (London);* **10**: No. 16, 2257-2268(11 Nov 1977).

Algorithms are presented for solving the reduced rate equations describing the population densities of different ion species in ionizing and recombining plasmas. Computationally, these models are efficient and can serve as an extension to numerical MHD models of plasmas. Their particular relevance to studies of plasmas produced by short laser pulses is illustrated by results from calculations on carbon plasmas. Comparisons are made between calculations using either a steady-state model for the ion population densities or the time-dependent models presented.

34190 **Generalized Ohm's laws for relativistically streaming plasmas.** Burman, R.R. (Western Australia Univ., Nedlands. Dept. of Physics). *Aust. J. Phys.;* **30**: No. 4, 471-480(Aug 1977).

A theoretical framework is given for treating dissipation and the associated diffusion of magnetic field lines resulting from 'frictional' interactions between different species in plasmas in which the species have relativistic streaming velocities. The plasmas are not necessarily neutral. One result is a form for generalized Ohm's laws. Details are given for binary plasmas, with particular attention paid to the analysis of inertial effects. Some remarks are made on the relevance of the results to pulsar magnetospheres.

34191 **Vlasov equilibrium in the KEMP II machine with realistic limits of plasma particle energy and momentum.** Matte, J.P.; Lafrance, G.; Gregory, B.C. (Quebec Univ., Varennes (Canada). Energy Research Centre). *Can. J. Phys.;* **55**: No. 6, 483-495(15 Mar 1977). (In French).

Plasma equilibria have been calculated numerically for the electromagnetic trap, KEMP II, from the Vlasov and Poisson equations. A plausible form for the electron and deuterium ion velocity distribution functions has been assumed. The present work provides a realistic treatment of the limits of integration in the expressions for the moments of the distribution functons in order to allow for energy and momentum values permitting the charged particles to escape the machine or encounter a material electrode. The parameters in the theory have been varied around reasonable estimates provided by experiments so that their influence on the equilibria could be studied. The densities predicted by our calclations are one to two orders of magnitude smaller than experimental estimates. We postulate that this difference is explained by the fact that our theory does not take into account electrons reflected by the classical mirror effect in the cusp regions of the KEMP II machine, thus preventing them from shieldng the anode potential.

34192 **Compton effect and pair production for relativistic particles in a plasma.** Kleiman, E.B.; Tsytovich, V.N. (Gor'kovskij Gosudarstvennyj Univ. (USSR)). *Zh. Eksp. Teor. Fiz.;* **72**: No. 1, 151-158(1977). (In Russian).

12 refs.; for English translation see the journal Sov. Phys. - JETP.

The probabilities for the compton effect and electron-positron pair production by two transverse quanta in an isotropic plasma are calculated. An expression for Compton energy losses of an electron is derived in the ultraquantum limit when the frequency of the initial quantum is close to that of the plasma. The energy losses prove to be proportional to electron energy epsilon rather than to ln epsilon as in the general Compton effect. It testifies to a considerable alteration of the nature of the radiation, the plasma significantly strengthening the radiation processes. The spectral intensity of the radiation from a system of ultrarelativistic electrons is found. An expression for quantum energy losses due to pair production is obtained, the effect of the medium being significant only at very large densities hωsub(pe)approximately $2mc^2$ (ωsub(pe)-plasma frequency).

34193 **Drift-kinetic equation for a rarefied plasma in the presence of short wave radiation.** Milant'ev, V.P. (Universitet Druzhby Narodov, Moscow (USSR)). *Zh. Eksp. Teor. Fiz.;* **72**: No. 1, 159-169(1977). (In Russian).

21 refs.; for English translation see the journal Sov. Phys. - JETP.

A derivation is given of an averaged kinetic equation for a collisionless plasma in a strong magnetic field B_0 in the presence of a quasimonochromatic high frequency (HF) radiation. The drift approximation is applied, the magnetic field of the HF wave being assumed negligible as compared to Bsub(0). In the absence of resonances the HF radition proves to have no effect on the drift-kinetic

equations in the zero and first approximation with respect to an expansion parameter. The effect emerges but in the second approximation. Kinetic equations in the second approximation are derived for the case of a longitudinal wave extending along a uniform magnetic field as well as for the case of a quasistationary HF radiation. A drift-kinetic equation under resonance conditions is derived and treated in the first approximation under the same assumptions. In the region of electron cyclotron-resonance the equation occurs to be even a zero approximation type.

PLASMA PRODUCTION

34194 **Target stimulated laser breakdown in air.** Cojocaru-Udrea, E.; Udrea, M.V.; Velculescu, V.G. (Institutul de Fizica Atomica, Bucharest (Romania)). *Rev. Roum. Phys.;* **21**: No. 7, 767-769(1976).

Letter-to-the-editor.

PLASMA INSTABILITIES

34195 (IAE—2629) **Particle diffusion in adiabatic traps with flute oscillations.** Putvinskii, S.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 12p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Channeled instability of plasma in an adiabatic trap has been analysed. A motion of plasma ions is observed in the field of a channeled wave and the coefficient of ion diffusion across the magnetic field is calculated in the presence of a monochromatic channeled wave in plasma. The energy of ions has been considered to vary under the action of cyclotron oscillations. The ion diffusion is shown to be more essential, provided the frequency of these oscillations is close to that of ion precession in an inhomogeneous magnetic field. When the frequency of oscillations is low, the electron diffusion becomes more essential and may lead to anomalously high ambipolar potentials in the trap. The theoretical results presented agree well with experiments, in which this combination of high- and low-frequency oscillations is observed.

34196 (IPP—6/157) **Dissipative MHD stability.** Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Apr 1977. 10p. (CONF-770475—1). Dep. NTIS (US Sales Only), PC A02/MF A01.

From 3. international conference on plasma theory; Triesta, Italy (19 Apr 1977).

A short survey of the literature on dissipative magnetohydrodynamic instabilities is given as introduction. A mathematical technique allowing 'energy principles' is developed and applied to toroidal equilibria and to cylindrical tokamak-like equilibria taking into account resistivity and the full macroscopic tensor, i.e. F.L.R. effects and viscosity. This allows to make statements about MHD stability in the presence of viscosity and F.L.R., and permits, without much computation, a qualitative and comparative study of resistive perturbations under the influence of F.L.R. and viscosity. Applications to tokamak observations are also sketched. Finally, it is proved that the stability of dissipative time-dependent force-free fields can be analyzed by a simple functional containing only the perturbed vector potential. This proof is valid even if all non-ideal effects of the two-fluid theory are considered. The conclusion contains a discussion of the open problems and suggestions are given for their solution.

34197 (IPPJ—267) **Diffusion of a multi-ion species plasma due to drift wave fluctuations.** Tange, T.; Itoh, K.; Inoue, S.; Nishikawa, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 31p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A general theory is presented for the diffusion of a multi-ion species plasma across magnetic field due to electrostatic fluctuations. The theory is based on the weak turbulence theory for an isothermal plasma in a slab geometry. It is shown that the diffusion flux due to wave-particle interactions is not necessarily proportional to the density gradient of the particle species of interest. The result is applied to the impurity diffusion due to those drift waves which exist in a single ion-species plasma. The dominant nonlinear effect is the induced scattering of waves on ions and the resulting diffusion constant of the host ions is given by the Kadomtsev formula, D -- $\gamma^2/k^2\omega$, where γ, ω and k are respectively the growth rate, frequency and wavenumber of the drift wave. The impurity diffusion constant is positive (or negative) if the impurity Larmour radius is smaller (or greater) than the host-ion Larmour radius, and becomes greater than the host diffusion constant if the spectrum is localized in the unstable region.

34198 (IPPJ—272) **Parametric decay of lower hybrid wave into drift waves.** Sanuki, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 17p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A dispersion relation describing the parametric decay of a lower hybrid wave into an electrostatic drift wave and a drift Alfven wave is derived for an inhomogeneous magnetized plasma. Particularly the stimulated scattering of a drift Alfven wave in such a plasma was investigated in detail. The resonance backscattering instability is found to yield the minimum threshold.

34199 (IPPJ—278) **Saturation of kink instability and helical equilibrium of current carrying plasma column.** Itoh, K.; Inoue, S.; Yoshikawa, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1977. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

By means of the neighbouring equilibrium method the saturation level of the kink instability of a current carrying plasma column is investigated. We obtain the helical equilibrium which is the stationary saturated stage of kink instability. The analysis is performed for the rounded current profile case and shows that the shell has very strong suppression effect on the saturation level.

34200 (IPPJ—279) **Real-space quasilinear theory of drift waves in a sheared magnetic field.** (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1977. 20p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A real-space quasilinear theory is developed for the collisional and the collisionless drift waves in a plasma with a sheared magnetic field of slab geometry. The equation obtained describes the interaction between many localized modes around different rational surfaces through the density modulation of the energy source region of each mode. The wave amplitudes approach to the stationary values through a relaxation oscillation process. When the width x sub(s) of the energy source region becomes comparable to the spacing Δx of the two adjacent rational surfaces, diffusion coefficient due to the wave is enhanced over the classical value, while the nonlocal heat transport due to the wave propagation is shown to be negligible compared to that associated with the diffusion process.

34201 (JAERI-M—7050) **Nonlinear saturation of dissipative trapped ion instability and anomalous transport.** Sugihara, M.; Ogasawara, M. (Japan Atomic Energy Research Inst., Tokyo). Apr 1977. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

An expression for the turbulent collision frequency is derived by summing up the most dominant terms from each order in the perturbation expansion in order to obtain the nonlinear saturation level of the dissipative trapped ion instability. Numerical calculation shows that the anomalous diffusion coefficient at the saturated state is in good agreement with the result of Kadomtsev and Pogutse when the effect of the magnetic shear is taken into account.

34202 (LAPS—34) **Drift cyclotron and lower hybrid drift instabilities with magnetic shear.** McBride, J.B.; Krall, N.A. (Science Applications, Inc., La Jolla, Calif. (USA). Lab. for Applied Plasma Studies). Dec 1977. Contract EY-76-C-03-1018. 22p. (SAI—77-984-LJ). Dep. NTIS, PC A02/MF A01.

Results from a stability analysis of drift cyclotron and lower hybrid drift instabilities in the presence of magnetic shear are presented. In the case of the lower hybrid drift modes, previous treatments are generalized to allow for finite electron gyroradius (k rho/sub e/ approximately greater than 1) in order to treat systems with T/sub e/ approximately T/sub i/. It is found that low density systems, with ω/sub pe/ less than ω/sub ce/, are much easier to stabilize with shear than are high density systems with ω/sub pe/ greater than ω/sub ce/. In the lower frequency drift cyclotron limit, shear leads to a reduction in the growth rate rather than to complete stabilization. It is found that shear becomes significant for vertical bar L/sub s//L/sub n/ vertical bar less than (m/sub i//m/sub e/)/sup $^1/_2$/ (rho/sub i//vertical bar L/sub n/ vertical bar)/sup $^1/_2$/.

34203 (ORNL/TM—6175) **Analytic model for the nonlinear interaction of tearing modes of different pitch in cylindrical geometry.** Carreras, B.; Waddell, B.V.; Hicks, H.R. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 49p. Dep. NTIS, PC A03/MF A01.

An analytic model has been developed for describing the nonlinear interaction of tearing modes of different pitch in cylindrical geometry for equilibria characterized by flat safety factor profiles. The analysis shows that the m = 2/n = 1 tearing mode can destabilize odd m modes, particularly the 3/2 mode. The model compares well with our three-dimensional (3-D) code with respect to the time evolution of the 0/0, 1/1, 2/1, 3/2, and 5/3 modes. Scaling rules are obtained for the position and location in time of the maximum or peak in the 3/2 growth rate. The characteristic time of destabilization of the odd m modes predicted by the model correlates well with the observed time scale for the major disruption in tokamaks.

34204 (TRITA-EPP—77-18) **Role of electrostatic instabilities in the critical ionization velocity mechanisms.** Raadu, M.A. (SEE ALSO- 6140550 Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Jul 1977. 24p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The role of electrostatic instabilities in the critical ionization velocity mechanism is investigated. The analysis is based on the theory developed by Sherman which interprets Alfven's critical velocity in terms of a circular process. A general expression for the energy and momentum of ions and electrons associated with an electrostatic mode is derived in terms of the plasma dielectric constant. This is used in the case of the modified two-stream instability to determine the distribution of energy between ions and electrons. An extrapolation from the linear phase then gives an estimate of the energy delivered to the electrons which is compared to that required to ionize the neutral gas.

34205 (TRITA-PFU—77-04) **Stability of ballooning modes in the boundary layer of a gas insulated plasma.** Ohlsson, D. (Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). Apr 1977. 49p. Dep. NTIS (US Sales Only), PC A04/MF A01.

In order to fulfill power density requirements in future steady-state fusion reactors the ion density in central parts must be of the order 10^{21} m^{-3}. In such systems high density neutral gas will surround the hot plasma, whether introduced on purpose or not, provided the neutral gas flux from the plasma is not continuously removed by external means. In these types of gas insulated plasmas large density and pressure gradients will arise close to the boundaries on account of plasma neutral gas interaction effects. In this paper the stability of gravitational driven ballooning modes in the boundary region is investigated. In particular, the coupling between plasma and neutral gas investigated in previous stability analysis is reconsidered. Also effects previously neglected for example the Nernst effect is taken into account.

34206 **Behaviors of absolute instabilities of electrostatic ion cyclotron waves in an ion beam-plasma system.** Sugawa, M.; Sugaya, R.; Nomoto, H. (Ehime Univ., Matsuyama (Japan)). *Phys. Lett., A;* **63**: No. 3, 321-323(14 Nov 1977).

Experimental results are presented for behaviors of the temporal growth and the threshold beam density of the absolute instability of the electrostatic ion cyclotron waves excited in an ion beam-plasma system, and compared with the linear theory.

34207 **Influence of random inhomogeneities on parametric interactions.** Bondeson, A. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Elektromagnetisk Faeltteori). *Phys. Scr.;* **15**: No. 1, 56-58(Jan 1977).

An investigation is made of parametric wave interactions in weakly turbulent media. Effective growth-rates and thresholds for mean amplitude and mean power growth are calculated allowing for arbitrary dampings of the excited modes and a nonzero average mismatch. Convective amplification in a linear mismatch profile is discussed.

PLASMA WAVE PHENOMENA

34208 (EUR-CEA-FC—905) **Ions and electrons thermal effects on the fast—slow mode conversion process in a three components plasma.** Fidone, I.; Gomberoff, L. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1977. 20p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Fast-slow mode conversion in a deuterium plasma with a small amount of hydrogen impurity, for frequencies close to the two-ion hybrid frequency, is investigated. It is shown that while electron thermal effects tend to inhibit the wave conversion process, ion thermal effects tend to restore, qualitatively, the cold plasma properties, favouring therefore, the energy exchange between the two modes. The aforementioned effects are competitive for zetasub(o)sup(e)=1/nsub(parall).vsub(e)>=1. For zetasub(o)sup(e)<=1, electron thermal effects, in particular Landau damping, dominate over ion Larmor radius effects, drastically diminishing the wave conversion efficacy. For zetasub(o)sup(e)<<1, the coupling between the modes disappears altogether.

34209 (EUR-CEA-FC—907) **Dupree's resonance function.** Rolland, P. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1977. 10p. Dep. NTIS (US Sales Only), PC A02/MF A01.

It is shown that Dupree's resonance function has a negative real asymptotic tail, so that the dispersion relation of the renormalized weak turbulence theory leads to unstable high phase velocity waves, even when the average distribution is a Gaussian. A possible explanation of this paradox is proposed.

34210 (IAE—2615) **Alfven wave instability in a two-component tokamak.** Bizli, K.O.; Lominadze, D.G.; Mikhailovskii, A.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 15p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Theoretically investigated is excitation of Alfven waves in a tokamak, its plasma containing a group of fast ions. It is supposed that fast ions are produced as a result of fast neutral atoms in ected in the tokamak. An expression is obtained for the increment of the Alfven oscillation growth at a arbitrary ratio between the transverse wavelength and the dimension of Larmor and drift orbits. The part of the finite orbit effect is analyzed for the case of a longitudinal beam with a small velocity spread and an arbitrary ratio of directed velocity V_0 to the Alfven velocity Csub(A). It is shown that at the finite ratio of V_0/Csub(A) the buildup is possible of two types of oscillations, corresponding to two signs of the ratio ω/ksub(long) (ω being the oscillation frequency, Ksub(long) being the longitudinal wave number). The increments of perturbations with ω/ksub(long)<0 turn out to exceed those at ω/ksub(long)>O.

34211 (IAE—2649) **Effect of trapped electrons on Alfven waves in a tokamak.** Mikhajlovskij, A.B.; Shukhman, I.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1976. 16p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

Interaction is theoretically investigated of Alfven waves with electrons trapped in plasma in a toroidal magnetic field. It is shown that at the finite ratio of the plasma pressure to the magnetic field pressure as a result of the interaction there may take place the wave buildup. The increment is defined by compressibility of the trapped electron gas and also by effects related to the finite value of the longitudinal electric field of disturbances. All these phenomena may be of interest for the problem of thermonuclear tokamak-reactors, and also for the magnetosphere plasma physics.

34212 (IPPJ—265) **Nonlinear propagation of the ordinary mode in a hot magnetoplasma.** Khiet, T.; Furutani, Y.; Ichikawa, Y.H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Nov 1976. 32p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Kinetic theory of the self-modulation of a quasi-monochromatic ordinary wave propagating across an external magnetic field is presented. Explicit expressions of the dispersion and the nonlinear coupling coefficients are given for a Maxwellian plasma. In the limit of zero-temperature, a Karpman-Kruskal linear stability of the O-mode envelop is discussed.

34213 (IPPJ—275) **Nonlinear electrostatic ion cyclotron waves in an rf-plugged inhomogeneous plasma slab.** Ikemura, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1977. 46p. Dep. NTIS (US Sales Only), PC A03/MF A01.

A theory based on the fluid and perturbation theories is developed to analytically study a nonlinear electrostatic ion cyclotron wave excited in an rf-plugged inhomogeneous plasma slab by applying a pair of external potentials phi sub(ext)(x,z) = +-PHI$_0$ cos ω_0 t.exp(-z²/2h²) at its boundaries x = +-L. Here, B_0 is applied along the z-axis. The potential forms of the fundamental and the nonlinear second harmonic are found as functions of x, z and t provided the field-free densities vary as exp(-x²/2d²)(d²/h² << 1). In the core region of the slab, the electric field (perpendicular to B_0) created by the fundamental potential can approximately be regarded as a dipole field, provided that /1-μ/ << 3 with μ=(ω$_0$²-ω sub(cl)sup(2))m sub(i)d²/(γ sub(i)T sub(i)+Z γ sub(e)T sub(e)). Under the stricter condition μ asymptotically equals 1, a dipole-like electric field can also be excited in the entire region for the case of high density and weak nonlinearity. It is shown that the assumption $\omega_0 << h^{-1} \vee \gamma$ sub(e)T sub(e)/m sub(e) can lead to the Boltzmann relation for the electron fluid even in inhomogeneous plasmas. Moreover, the density depletion delta N sub(i) obtained here contains a new considerable term proportional to /phi/², in addition to the usual term proportional to -/delta phi/delta x/² which originates from the ponderomotive force.

34214 (IPPJ—277) **Contribution of higher order terms in the reductive perturbation theory. II. A case of strongly dispersive wave.** Ichikawa, Y.H.; Mitsuhashi, T.; Konno, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1977. 21p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Contribution of higher order terms in the reductive perturbation theory has been investigated for nonlinear propagation of strongly dispersive ion plasma wave. The basic set of fluid equation is reduced to a coupled set of the nonlinear Schroedinger equation for the first order perturbed potential and a linear inhomogeneous equation for the second order perturbed potential. A steady state solution of the coupled set of equations has been solved analytically in the asymptotic limit of small wave number.

34215 (KFTI—74-36, pp 70-75) **Effect of magnetic surface parameters on low-frequency fluctuations of plasma.** Voitsenya, V.S.; Voloshko, A.Yu.; Solodovchenko, S.I.; Tereshchenko, F.F.; Zakharov, A.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. (In Russian).

In Nuclear science and engineering problems.

A study was made of the effect of "average min V" and "average max V" of the intersections of lines of force at low

frequency (ω approximately 100 kHz) oscillations of density and potential in plasma produced in the ultra-high-frequency discharge of the Saturn stellarator. It was shown that the oscillation level decreases both with average min V in the reservoir volume (several percent) and with a rather large width.

34216 (RISO-M—1911) **Nonlinear electron plasma waves in a cylindrical waveguide.** Rasmussen, J.J. (Research Establishment Risoe, Roskilde (Denmark)). Mar 1977. 40p. Dep. NTIS (US Sales Only), PC A03/MF A01.

The nonlinear behaviour of the electron plasma wave propagating in a cylindrical plasma waveguide immersed in an infinite axial magnetic field is investigated using the Krylov-Bogoliubov-Mitropolsky perturbation method, by means of which the nonlinear Schroedinger equation, governing the long-term slow modulation of the wave amplitude, is deduced. From this equation the amplitude-dependent frequency and wavenumber shifts are calculated, and it is found that the electron waves with short wavelengths are modulationally unstable with respect to long wavelength, low frequency perturbations. The growth rate of the instability is calculated and possible applications to experiments are discussed.

34217 (RISO-M—1950) **Pulse propagation and instabilities in an ion beam plasma system and the interaction between electron plasma waves and ion-acoustic waves.** Rasmussen, J.J. (Research Establishment Risoe, Roskilde (Denmark)). Aug 1977. 98p. (In Danish). Dep. NTIS (US Sales Only), PC A07/MF A01.

Shows how to calculate propagation patterns of ion-acoustic density pulses in an ion beam plasma system in both stable and unstable situations, for different types of excitation. The propagation pattern is largely governed by the method of excitation. An experimental investigation was carried out of an electrostatic ion-cyclotron instability in a Q machine plasma, excited by an ion beam. The results are compared with theoretical predictions. Experimental observations of the interaction between ion-acoustic waves and electron-plasma waves are also discussed, as well as the possibility of using electron-plasma waves for the stabilisation of low-frequency instabilities. All these investigations were confined to linear effects. The results may be of some importance in the heating of a fusion plasma by the injection of neutral particles.

34218 (SU-IPR—725) **Diagnosing oscillatory growth or decay.** Buneman, O. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Dec 1977. Contract EY-76-C-03-0326-036. 7p. Dep. NTIS, PC A02/MF A01.

An analytical study is presented for an oscillatory system in terms of four constants, namely amplitude, phase, growth or decay rate, and frequency. (MOW)

34219 (UCID—17683) **Wave-propagation and energy-conservation checks for electron-fluid, radial SUPERLAYER code.** Condit, W.C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1977. Contract W-7405-ENG-48. 16p. Dep. NTIS, PC A02/MF A01.

A vesion of the SUPERLAYER code has been modified to include the effect of plasma electrons treated as a massless fluid. This report describes tests of the code under input conditions that should guarantee the validity of the cold-plasma MHD wave solution described by Berk and Pearlstein.

34220 Observation of the azimuthal angle of T-D mode induced scattering from ion sound wave parametrically excited in T-D resonance. Ikezawa, S.; Sunamori, S. (Chubu Inst. of Tech., Kasugai, Aichi (Japan)). *Phys. Lett., A;* **63**: No. 3, 285-287(14 Nov 1977).

The T-D mode is induced scattering from the excited ion sound wave toward the azimuthal angle of about 30 degrees at a saturated state where the input electromagnetic wave decays into the ion sound wave and the T-D resonance parametrically.

34221 Two-dimensional solitons of the Kadomtsev-Petviashvili equation and their interaction. Manakov, S.V.; Zakharov, V.E. (L.D. Landau Institute for Theoretical Physics, Moscow, USSR); Bordag, L.A.; Its, A.R.; Matveev, V.B. (Leningradskij Gosudarstvennyj Univ. (USSR)). *Phys. Lett., A;* **63**: No. 3, 205-206(14 Nov 1977).

Explicit analytic formulae for two-dimensional solitons are given. It is proved that, unlike one-dimensional solitons, two-dimensional ones do not interact at all.

34222 Plasma oscillation in the void lattice. Ohtaka, K. (Facultes Universitaires Notre-Dame de la Paix, Namur (Belgium)). *Phys. Lett., A;* **63**: No. 3, 298-300(14 Nov 1977).

The plasma oscillation in the void lattice is examined by solving an integral equation obtained from the Maxwell's equations. The previous results are not only for the monopolar plasma oscillation but also for the other multipolar plasma oscillations.

34223 Observation of current driven ion sound wave in a turbulently heated plasma (the MACH II). Amagishi, J.; Iguchi, H.; Ito, Y.; Kawabe, T.; Mase, A.; Tsukishima, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). *Phys. Lett., A;* **63**: No. 1, 31-34(17 Oct 1977).

Dynamic behaviors of the turbulence are measured in a turbulently heated plasma by microwave scattering method. The phase velocity of the wave increases with time. The value of the phase velocity is found to be consistent with that of the ion sound wave propagating across the magnetic field, when the increase of the phase velocity is interpreted as due to the increase of the electron temperature.

34224 Tubulence spectrum of the ion acoustic wave in a large volume plasma. Kawai, Y.; Hollenstein, Ch. (Ecole Polytechnique Federale, Lausanne (Switzerland)). *Phys. Lett., A;* **63**: No. 1, 42-44(17 Oct 1977).

As the fluctuation level of the ion acoustic wave increases, the wave energy transfers towards the low frequencies, and the turbulence spectrum agrees with that proposed by Horton et al.

34225 Emission and absorption of Langmuir waves by anisotropic unmagnetized particles. Melrose, D.B.; Stenhouse, J.E. (Australian National Univ., Canberra. Dept. of Theoretical Physics). *Aust. J. Phys.;* **30**: No. 4, 481-493(Aug 1977).

The emission and absorption coefficients for Langmuir waves due to anisotropic unmagnetized particles are reduced to two complementary forms: one involving integrals over momentum p and pitch angle α; the other involving an integral over p and a sum over Legendre polynomials. The quasilinear diffusion coefficients are reduced to the former. It is also shown how the absorption coefficient may be reduced to forms involving neither a p derivative nor an α derivative. The results have important implications in connection with the theory of solar radio bursts.

34226 Anomalous absorption of electromagnetic radiation in a randomly inhomogeneous collisionless magnetoactive plasma. Ryzhov, Yu.A. (Gor'kovskij Gosudarstvennyj Univ. (USSR). Nauchno-Issledovatel'skij Radiofizicheskij Inst.). *Zh. Eksp. Teor. Fiz.;* **72**: No. 1, 141-150(1977). (In Russian).

12 refs.; 2 figs.; for English translation see the journal Sov. Phys. - JETP.

The mechanism of energy losses of electromagnetic radiation in a collisionless magnetoactive plasma due to excitation of scattered normal waves is considered under conditions when their refraction coefficients may be infinite. The excitation of quasilongitudinal waves near resonant directions occurs on scattering of the waves by inhomogeneities of the plasma electron density. The case of $U=\omega_{sub(H)}^2/\omega^2<1$ ($\omega_{sub(H)}=/e/H/MC$-electron hydrofrequency, ω-wave circular frequency), when the resonant wave is the extraordinary one, is analysed at greater length. A tensor of effective dielectric permittivity of the magnetoactive plasma is described. Both isotropic small-scale inhomogeneities and large-scale inhomogeneities extended along the magnetic field are considered. It is pointed out that the mechanism described may be employed for plasma high-frequency heating.

34227 Stationary Langmuir spectra in an inhomogeneous plasma. Kovrizhnykh, L.M.; Sakharov, A.S. (AN SSSR, Moscow. Fizicheskij Inst.). *Zh. Eksp. Teor. Fiz.;* **70**: No. 4, 1274-1277(Apr 1976). (In Russian).

For English translation see the journal Sov. Phys. - JETP.

The effect of a weak plasma inhomogeneity on the structure of the Langmuir spectra is considered by taking into account stimulated scattering by ions. General properties of the solution for the spectral density of the Langmuir oscillations with a source and sink of plasmons are determined within the framework of a one-dimensional model. Numerical solutions are obtained in the case when the role of stimulated scattering is relatively small.

FUSION POWER PLANT TECHNOLOGY

34228 (EUR-CEA-FC—884(Pt.1)) **Annual progress report of the Fontenay-aux-Roses Research Group. January 1 to December 31, 1976.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 168p. (In French). Dep. NTIS (US Sales Only), PC A08/MF A01.

The program of exploitation of TFR 400 consisted in two main research subjects: energy balance in the discharges of TFR 400 and the development of heating techniques (neutral injection and cyclotron heating). Theoretical studies on Tokamak physics, enhanced by numerical simulation, were especially concerned with the thermal conductivity of electrons, impurity transport, MHD breakdown instabilities, and the plasma turbulence. Some ion sources (duopigatron) and neutral injectors (periplasmatron) were developed. The TFR 600 program started with some works on new TFR parts (the vacuum chamber) and heating improvement (neutral injection and also granion injection in INGRA). Detailed design studies and tests relating to the 'TORE II' project continued. Researches under contract effected for JET were concerned with reliability and the vacuum chamber and mechanical structures.

34229 (GA-A—14614(Vol.4)) **GAC—ANL TNS scoping studies. Status report for FY-77, October 1, 1976—September 30, 1977. Volume IV. Reactor engineering.** (General Atomic Co., San Diego, Calif. (USA)). Oct 1977. Contract EY-76-C-03-0167-038. 139p. Dep. NTIS, PC A07/MF A01.

Conceptual designs have been developed for a 3.8 m Ignition Test Reactor (ITR) and a 4.2 m Upgradable Ignition Test Reactor (UITR). Both reactors are based on a doublet plasma cross section which enables them to achieve high β. The 3.8 m ITR is designed to achieve D-T ignition and maintain 30-second burns at a low duty factor of 0.1. The 4.2 m UITR is designed to be operated initially as an ITR and later be upgraded for net power Experimental Power Reactor (EPR) operation at a duty factor of 0.78. Both reactors utilize a water-cooled Inconel 625 plasma chamber with graphite tiles lining the inboard walls and movable limiters at the top and bottom of the chambers. The exposed walls of the chamber are coated with a carbon deposit. Water-cooled tungsten blocks, stacked in annular stainless steel tanks together with the inboard field-shaping coils, are used as the inboard shield. Water-cooled steel with lead cover layers is used for the bottom shield, while the other outboard shields are built up of stainless steel, boronated water, and lead. Both designs employ 12 superconducting NbTi toroidal field coils built up in pancake windings with stainless steel interleaving the conductor windings.

34230 (IAE—2537) **Comparison of physical parameters of a tokamak with circular and elongated cross-section of a plasma filament.** Bortnikov, A.V.; Brevnov, N.N.; Gerasimov, S.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1975. 18p. (In Russian). Dep. NTIS (US Sales Only), PC A03/MF A01.

Plasma parameters have been analytically compared in tokamaks with a circular plasma filament cross section and that extended along the main axis, under the assumption that the energy and the maximum value of the toroidal magnetic field strength are equal. It has been assumed that the distance from the system axis to the internal boundary of the plasma filament and that from the filament boundary to the toroidal field windings are equal in both cases. Possible ignition of a thermonuclear reaction in the tokamak-reactor with a noncircular cross section with the help of joule heating is considered. It follows from the estimates that in the ring-shaped tokamak-reactor of reasonable sizes it is possible to realize ignition using the joule heating only, or to decrease significantly the required power of supplementary heating as compared with the corresponding circular tokamak.

34231 (IPP—4/147) **Energy by nuclear fusion. Physical fundamentals, energy reserves, state of plasma physics, reactor projects, key problems, safety, and environmental impact.** Buende, R.; Daenner, W.; Herold, H.; Raeder, J. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Dec 1976. 179p. (In German). Dep. NTIS (US Sales Only), PC A09/MF A01.

This report reviews the state of knowledge in a number of fields of fusion research up to autumn 1976. Section 1 gives a very brief presentation of the elementary fusion reactions, the energies delivered by them and the most basic energy balances leading to Lawson-type diagrams. Section 2 outlines the reserves and cost of lithium and deuterium, gives estimates of the total energy available from DT fusion and comments on production technology, availlability and handling of the fuels. In section 3 a survey is given of the different concepts of magnetic confinement (stellarators, tokamaks, toroidal pinches, mirror machines, two-component plasmas), of confinement by walls, gas blankets and imploding liners and, finally, of the concepts of interial confinement (laser fusion, beam fusion). The reactors designed or outlined on the basis of the tokamak, high-β, mirror, and laser fusion concepts are presented in section 4, which is followed in section 5 by a discussion of the key problems of fusion power plants. The present-day knowledge of the cost structure of fusion power plants and the sensitivity of this structure with respect to the physical and technical assumptions made is analysed in section 6. Section 7 and 8 treat the aspects of safety and environment. The problems discussed include the hazard potentials of different designs (radiological, toxicological, and with respect to stored energies), release of radioactivity, possible kinds of malfunctioning, and the environmental impact of waste heat, radiation and radioactive waste (orig.).

34232 (UCRL—80667) **Technology requirements for fusion—fission reactors based on magnetic-mirror confinement.** Moir, R.W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Jan 1978. Contract W-7405-ENG-48. 23p. (CONF-771155—3). Dep. NTIS, PC A02/MF A01.

From 2. DMFE hybrid reactor meeting; Washington, DC, USA (2 Nov 1977).

Technology requirements for mirror hybrid reactors are discussed. The required 120-keV neutral beams can use positive ions. The magnetic fields are 8 T or under and can use NbTi superconductors. The value of Q (where Q is the ratio of fusion power to injection power) should be in the range of 1 to 2 for economic reasons relating to the cost of recirculating power. The wall loading of 14-MeV neutrons should be in the range of 1 to 2 MW/m^2 for economic reasons. Five-times higher wall loading will likely be needed if fusion reactors are to be economical. The magnetic mirror experiments 2XIIB, TMX, and MFTF are described.

34233 **Magnetic mirror research points towards compact fusion power system.** Post, R.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). *Nucl. Eng. Int.;* **22**: No. 236, 59-63(Oct 1977).

Recent experimental success in achieving the confinement of high temperature, high pressure plasma using magnetic mirror effect may point the way to the development of compact fusion power systems. Based on these successes, the tandem mirror and the field reversed mirror are being studied as ideas which could favourably impact the economics of mirror-based fusion power plants. The status and prospects of these systems are discussed.

34234 **Heading for the fusion reactor.** Zankl, G. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). *J. Inst. Nucl. Eng.;* **18**: No. 6, 167-173(1977).

The development of a fusion reactor is discussed under the following main headings, with emphasis on a D-T reactor, which is stated to afford the best chance of success. -Concept of a fusion power plant; geometrical dimensions of fusion devices; the potential of nuclear fusion; development of plasma physics; the next fusion experiments (the tokamak fusion test reactor and the Joint European Torus); problems of fusion orientated plasma physics; different ways of heating a plasma; the problem of impurities; and the various fusion programmes.

34235 **Proceedings of the seventh symposium on engineering problems of fusion research. Volume II.** Lubell, M.S.; Whitmire, C. Jr. (eds.). Contract W-7405-ENG-26. New York; Institute of Electrical and Electronics Engineers, Inc. (1977). 931p. (CONF-771029—P2). Service Center, Piscataway, NJ.

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

Separate abstracts were entered into the data base for each of the 95 included papers. The remaining papers were entered into the data base previously. (MOW)

34236 **Concepts for D-^{3}He satellite reactors.** Miley, G.H.; Southworth, F.H.; Choi, C.K.; Wang, M.Y.; Gerdin, G.A.; Driemeyer, D. (Univ. of Illinois, Urbana). pp 1172-1176 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The potential advantages of employing D-^{3}He satellites along with D-T (or eventually D-D) ^{3}He generator plants are discussed. A variety of satellite sizes are envisioned (3 GW to 10 MW), and this, along with the relative cleanliness and maintainability of D-^{3}He systems, suggests considerable freedom in deployment of the satellites. Further details related to the Field-Reversed Mirror satellite are presented because of its unique position as potentially being the smallest (approximately 10 MWe) magnetically confined fusion power plant.

34237 **Energy and physics.** Kapitsa, P.L. *Vestn. Akad. Nauk SSSR;* No. 1, 34-43(1976). (In Russian).

The development of large power energy sources is reviewed in the light of fundamental limitations imposed by nature on the energy flux density. The energy sources based on electrostatic generators, gas units (direct conversion of hydrogen oxidation chemical energy to electric one), solar batteries, geothermal energy, wind power and hydroelectric power appear to be unpromising. The solution of the world energy crisis is connected with nuclear energy, and, first of all, with thermonuclear reaction of deuterium and tritium nuclei. In contrast to uranium employment the thermonuclear process produces no significant quantity of radioactive wastes, runs far less risk during accidents and cannot be used as an explosive. The realisation of a controlled thermonuclear reaction is pointed out to face a number of physical and technical problems still to be solved.

34238 **Proceedings of the 9th symposium on fusion technology, Garmisch-Partenkirchen (FRG), June 14-18, 1976, organized by IPP - Institut fuer Plasmaphysik, Garching (FRG).** Oxford; Pergamon Press for the Commission of the European Communities (1976). 850p. (EUR—5602).

From 9. Symposium on fusion technology; Garmisch-Partenkirchen, Germany, F.R. (14 - 18 Jun 1978).

Some papers previously published by ZAED as AED-Conf-309 (in abstract form) and others published as Conf-760631 are indexed in INIS Atomindex vol. 7, 1976.

34239 Thermonuclear investigation development. Review of patents. Pistunovich, V.I.; Solov'ev, N.S. *At. Tekh. Rubezhom;* No. 9, 28-31(Sep 1975). (In Russian).

The patent situation, based mainly on a study of the situations of Great Britain, USA, France, Federal Republic of Germany and Japan from 1958 to 1974 is reviewed. Applicants have obtained around 300 patents on equipment for control of thermonuclear reactions. In the second half some decrease in the introduction of patents on high-temperature-plasma studies is noted. Multipole magnet systems for holding plasma and toroidal equipment of the takamak type have been developed recently. In the 70s, patents were published on the use of high-energy electrons for stabilization and heating of plasma in toroidal stationary systems. Starting with the mid 60s, considerable attention has been given to heating of plasma with laser radiation and to conversion of thermonuclear energy to electrical. There are 20 domestic patents on laser heating of plasma, and 75 and 45 domestic patents, respectively, on open and composite traps and 120 and 40 such patents abroad. While in the 60s equipment of different types was patented in many directions, part of which has not found further use, today work abroad is being patented basically on laser heating of plasma, toroidal magnetic systems, ion beam interference, and plasma bunching.

BLANKET ENGINEERING

REFER ALSO TO CITATION(S) 33465, 34084, 34286

34240 (EUR-CEA-FC—896) **Experiments varying the plasma radius on TFR.** (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Equipe TFR). May 1977. 44p. (In French). Dep. NTIS (US Sales Only), PC A03/MF A01.

The macroscopic characteristics of TFR plasmas have been investigated in the limiter radius range: a = 12,5 up to 19 cm and with two different materials for the limiter: molybdenum or graphite. The energy confinement time varies approximately as a^2 and the central electron temperature increases as a at the power 1.3. The concentration in light impurities decreases as the distance between the plasma surface and the wall increases; the same effect is observed for the heavy impurities as the limiter consists of graphite.

34241 (GA-A—14614(Vol.3)) **GAC—ANL TNS scoping studies. Reactor physics, status report for FY-77, October 1, 1976—September 30, 1977.** (General Atomic Co., San Diego, Calif. (USA)). Jan 1978. Contract EY-76-C-03-0167-038. 126p. Dep. NTIS, PC A07/MF A01.

The important physics considerations involved in the current TNS tokamak design are divided into four parts: (1) PLASMA DYNAMICS: The minimum β required for ignition is shown to be insensitive to the transport scaling used (with β approximately 5%). It is also argued that particle diffusion alone may set an upper limit to the β-value achievable in a tokamak. (2) PLASMA HEATING: The theory of lower hybrid (LH) heating of a tokamak plasma is presented with applications to the current TNS models. (3) PLASMA SHAPING AND MHD: The double layer field shaping coil and the doubly indented "peanut" systems are analyzed from the standpoints of stability, control, and external power demands. (4) PLASMA BOUNDARY PHYSICS: The behavior of potential limiter materials under thermonuclear burn conditions is examined. A combination of Be-Ni and carbon are shown to best satisfy current TNS requirements, with carbon serving in the high load regions. The surface physics involved along the first wall is shown to have a strong impact on the efficiency of any vacuum pumping system.

34242 (IAEA—199, pp 139-174) **Data needs for plasma surface interaction.** Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion. Proceedings of an advisory group meeting organized by the IAEA held at the UKAEA Culham Laboratory, Abingdon, UK, 1-5 November 1976.

Requirements for data on surface phenomena important for plasma surface interactions are given. These include yields for sputtering by light ions, data on reflection and trapping of hydrogen, information about blistering and yields for desorption of adsorbed gases by ions, electrons and photons. The importance of plasma surface interaction is explained, the data requirements for the different types of plasma machines and reactors are outlined. After a short description of the present state of knowledge of the individual processes a discussion of possible synergistic effects is presented. They are shown to be important but without dramatic consequences according to our present knowledge.

34243 (IPP—4/149) **Mechanical performance of the fusion reactor first wall. Pt. 2. Behaviour under pulsed load conditions.** Daenner, W.; Raeder, J. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Mar 1977. 102p. Dep. NTIS (US Sales Only), PC A06/MF A01.

While the first part of this report was concerned with the steady-state mechanical analysis of the fusion reactor first wall, this part deals with the analysis based upon pulsed load conditions. In a first section we elaborate various solutions of the non-stationary heat conduction problem in plane geometry capable of describing the temperature response of the wall due to characteristic plasma pulse sequences. these solutions are input to a quasi-steady-state stress and strain analysis. Finally, the results of this analysis are set in relation to the fatigue properties of the wall material. A further section presents a description of a computer program which uses the mathematical procedure described. The results of some test runs are followed by those of detailed parameter studies. In the course of these calculations the influences of a number of design and operational quantities of a fusion reactor were investigated. It turned out that the choice of wall thickness and wall loading are of predominant importance for the first wall fatigue life.

34244 (IPP—4/152) **Neutral-particle-based divertor model for Tokamak reactors.** Emmert, G.A. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (Germany, F.R.)). Apr 1977. 17p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A zero-dimensional divertor model is derived from one-dimensional 'fluid' equations for the plasma and neutral particles. In this model the important process determining wall bombardment is charge exchange between the background neutral gas and the ions. Simple formulas are presented for the rate of wall bombardment, for the mean temperature and for the shielding efficiency of the plasma in the scrape-off zone. Only the latter parameter is strongly dependent on the parallel transport process in the scrape-off zone. None of the parameters are dependent on the perpendicular transport process. The model shows reasonable agreement with the one-dimensional computer simulation calculations of Mense.

34245 (JAERI-M—6811) **Response distributions of ^{6}LiF and ^{7}LiF thermoluminescence dosimeters in lithium blanket assemblies.** Maekawa, H.; Kusano, J.; Seki, Y. (Japan Atomic Energy Research Inst., Tokyo). Nov 1976. 16p. Dep. NTIS (US Sales Only), PC A02/MF A01.

Measurement of the radiation-heating rate distribution in the fusion blanket is as important as measurement of the fission-rate distribution in a fission reactor. To obtain the information of radiation heating, the response (integral glow value) distributions in pseudo-spherical lithium assemblies with and without a graphite reflector were measured with ^{6}LiF and ^{7}LiF TLD's. The measured responses are normalized to values per source neutron. Experimental error is about 35%, and the error in positions of TLD's is about +- 3 mm. The experimental results are compared with those of calculation using RADHEAT code system and ENDF/B-III data file.

34246 (PPPL—1388) **Blister divertor for tokamaks.** Gralnick, S.L. (Princeton Univ., N.J. (USA). Plasma Physics Lab.). Jan 1978. Contract EY-76-C-02-3073. 16p. Dep. NTIS, PC A02/MF A01.

The results of model calculations that demonstrate the feasibility of producing the required blister region and a preliminary evaluation of the divertor collection efficiency are presented. (MOW)

34247 (SAND—77-0908) **Scope of work for evaluating the mechanical performance of EPR first wall coatings.** Jones, W.B.; Van Den Avyle, J.A. (Sandia Labs., Albuquerque, N.Mex. (USA)). Jan 1978. Contract EY-76-C-04-0789. 15p. Dep. NTIS, PC A02/MF A01.

An outline is presented for a proposed scope of work to evaluate the mechanical performance of candidate first wall coatings for a Tokamak-type fusion reactor. The goal of the overall program is to provide an adequate coating material and recoating process which can be manufactured by currently available vendors.

34248 Preconceptual evaluation of a helium cooled molten salt hybrid blanket. Aase, D.T.; McCann, R.A. (Battelle Pacific Northwest Labs., Richland, WA). pp 1177-1180 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Recent neutronic parametric studies indicated that a relatively complex hybrid blanket was needed to obtain the balance of tritium and fissile fuel production and power necessary to yield a commercially attractive TCT-Hybrid. One region of that blanket is made up primarily of molten salt (Flibe) and graphite. Its function is to breed tritium and generate power from plutonium fissions. Rather than circulate the salt to remove the power, it appeared attractive to consider helium cooling the salt. The question that needed to be answered in a preconceptual analysis was whether or not the constraints on graphite, structural material, and salt temperatures could

be met with helium cooling and still maintain material fractions of interest neutronically. To stay within the structural material fractions desired, it would be necessary to transfer the heat generated by conduction and convection to rows of helium cooling tubes at the outside of the two burner regions. The analysis indicated two things. First, heat transfer across the salt region was by natural convection. The salt has a very low thermal conductivity. Secondly, He cooling tubes at the sides of the region do not provide adequate heat transfer surface area. It takes 2½ times as many tubes located on both sides of the burner subregions and in the center of the moderator subregion to maintain the desired graphite and 316 SS temperatures. Increasing the number of tubes doubled the volume fraction of 316 SS. It was found this cut the tritium and fissile material production in half which would require increasing the plutonium and Li^6 enrichment in the salts. If this proves to be economically unattractive, the alternate to consider is removing heat from the region by circulating the salt with the attendant complexities in heat removal system and structural design.

34249 Tokamak hybrid blanket design. Teofilo, V.L.; Leonard, B.R. Jr.; Perry, R.T.; Bampton, M.C.C.; McKinnon, M.A.; Bloomster, C.H.; Fassbender, L.L. (Battelle Pacific Northwest Labs., Richland, WA). pp 1181-1184 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Battelle, Pacific Northwest Laboratories (PNL) has recently evaluated the fissile fuel producing capability of the Tokamak Engineering Test Reactor (TETR) which had been designed by the University of Wisconsin to produce a high neutron flux for engineering and materials testing. To accomplish this, a blanket was designed based upon near term fission reactor technological developments. With this in mind, and with a view toward maintainability, it is located in the outside blanket region and fueled with natural uranium oxide to obtain the maximum production of plutonium. With helium as a coolant, 316 SS was selected for both fuel cladding and modular blanket assembly structure whose dimensions are restricted by the poloidal field coils, divertor channels, and neutral beam ports of the fusion driver system. For the TETR duty cycle and neutron power distribution, this blanket generates 780 MW of thermal power together with 740 kg of plutonium per year. The enhanced breeding performance of technologically advanced fuels has also been evaluated for this blanket design in addition to its potential for breeding tritium. The cost of this fabricated modular blanket structure together with its initial fuel inventory has been estimated to be less than $50M (1976).

34250 Bundle divertor designs for the ILB Advanced Fuel Tokamaks. Swift, G.M.; Southworth, F.H. (Univ. of Illinois, Urbana). pp 1198-1202 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

A divertor is generally considered to be a necessary part of a power-producing tokamak. The bundle divertor has been modeled in order to gauge the feasibility of using a bundle divertor to perform an unusual function: linking a tokamak to a direct collector. To that end, reference bundle divertor designs for five ILB Advanced Fuel Tokamaks (designed by the University of Illinois, Lawrence Livermore Laboratory, and Brookhaven National Laboratory) are presented. The expected gains in electrical conversion efficiency of these advanced fuel tokamaks with bundle divertor-direct collector systems are given. It appears that cryogenic aluminum bundle divertor coils are better suited for use with direct collectors than either Nb_3Sn superconducting or warm copper normal-conducting coils.

MAGNET COILS AND FIELDS

REFER ALSO TO CITATION(S) 33526, 33527, 33528

34251 (IPPJ—260) **Equilibrium of REB-ring with soft-core.** Ikuta, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1976. 11p. Dep. NTIS (US Sales Only), PC A02/MF A01.

A equilibrium configuration of a charge-neutralized toroidal relativistic electron beam (REB ring) with a current-carrying plasma column to provide the toroidal field is calculated analytically. This plasma column is called soft-core. There exists an equilibrium of REB ring with a stable soft-core provided that the length of the core is shorter than a critical length.

34252 (IPPJ—271) **Rotational transform angle of the stellarator field with twisted coils.** Ohasa, K.; Miyamoto, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Dec 1976. 13p. Dep. NTIS (US Sales Only), PC A02/MF A01.

The stellarator field produced by the system of twisted coils in the linear configuration is studied analytically. The current of this system can be represented by the superposition of the azimuthal components and the helical components. The rotational transform angle of this system is analyzed. It is found that the fundamental harmonic of the helical components of the current distribution gives the major contribution to the rotational transform angle. The numerical results in the case of the toroidal configuration are compared with the analytical results.

34253 (NIIEFA-LM—0258) **Equilibrium of longitudinal-field winding unit under the action of lateral forces in a tokamak devices.** Karnaukh, V.A.; Spirchenko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1976. 15p. (In Russian). Dep. NTIS (US Sales Only), PC A02/MF A01.

The problem of equilibrium of a longitudinal-field winding unit under lateral forces resulting from the interaction between the winding current and control field in tokamak-type installations is discussed. Two cases of equilibrium are considered: 1. Restoring moment depends only upon the unit thrust forces acting on the core. 2. Restoring moment depends on thrust and reactive forces of a force framework. The second case is considered on the T-10 installation. The calculation of the framework stressed-state is given.

34254 General Dynamics Convair conceptual design of a test coil for the Large Coil Program. Hackley, D.S.; Waszczak, J.P. (General Dynamics/Convair, San Diego, CA). pp 920-925 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This paper describes the superconducting coil designed for the Large Coil Program by the General Dynamics Convair, Intermagnetics General Corp., and Magnetics Engineering Associates industrial team. The coil case is a simple, all-welded, 304L stainless steel structure, minimizing the number of parts and the number of machined surfaces. The layer-wound conductor is finned, monolithic, OFHC copper encasing a NbTi superconducting cable soldered in a central slot. The coil reacts all operating and fault condition loads while keeping deflections low. We have shown analytically that the conductor is unconditionally stable under all credible events. The structural case features simplified parts fabrication, straightforward weld processes, and good inspectability. The conductor process line is arranged to ensure conductor integrity and inspectability. Winding the layers between bobbin side plates ensures a tight conductor pack.

34255 General Electric conceptual design of a test coil for the Large Coil Program. Quay, R. (General Electric Co., Schenectady, NY); Bryant, R.W.; Koenig, R.F.; Ferrante, J.J.; Linkinhoker, C.L.; Donato, J.W.; Heinrich, J.P.; Markiewicz, W.D.; Zeitlan, B.A.; Rhodenizer, R.L. pp 926-930 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

A conceptual design for a toroidal field (TF) coil for a six coil test array has been developed. The electromagnetic, cryogenic, structural, manufacturing, quality assurance and verification testing requirements have been analyzed. The bore is oval shaped and is 2.35 meters horizontally and 3.35 meters vertically. The coil is designed to operate at 8T peak field at rated current of 10450 amperes when the other 5 coils in the toroidal array are at 80 percent rated current. Using flat-wound NbTi conductor this pool-boiling, pancake wound coil is fully cryostable, and is enclosed in a 316LN stainless steel coil structure and helium container capable of supporting all expected in-plane loads and out-of-plane loads due to pulsed fields and unsymmetrical current distributions in the other 5 coils.

34256 Conceptual studies of toroidal field magnets for an experimental power reactor. Heinrich, J.P. (Intermagnetics General Corp., Guilderland, NY); Ackermann, R.A.; Rackov, P.M.; Rhodenizer, R.L.; Walker, M.S.; Zeitlin, B.A.; Markiewicz, W.D.; Ferrante, J.J.; Bryant, R.W.; Quay, R. pp 931-934b of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Concepts for 8 T and 12 T EPR TF coils have been developed. Approaches for conductor, winding and cryomechanical designs have been defined for each concept. Fabrication methods have been selected and cost and schedule estimates have been prepared. Major uncertainties have been identified and R and D programs have been recommended to supply required design data.

34257 Westinghouse conceptual design of a test coil for the Large Coil Program. Heyne, C.J.; Young, J.L.; Hackworth, D.T. (Westinghouse Electric Corp., Pittsburgh). pp 935-939a of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The trend toward high magnetic fields in the development of Tokamak fusion reactors has increased interest in forced flow Nb_3Sn superconducting toroidal field coils. The Large Coil Program, administered by Union Carbide Corporation, has funded the development of such a magnet to determine its feasibility for use in the magnetic fusion energy effort. Conceptual design work aimed at the production of an 8 tesla peak field magnet for this program has been completed by Westinghouse Electric Corporation. The design concept resulting from this study, and its applicability to the long range Tokamak fusion reactor program are discussed.

34258 Design considerations for the Nb_3Sn forced flow conductor for LCP. Sanger, P.; Adam, E.; Marancik, W.; Poulsen, S. (Airco Central Research Labs., Murray Hill, NJ). pp 948-951 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The use of a Nb_3Sn superconductor in a forced flow LCP system places unique requirements on the conductor design and the fabrication techniques adopted. A program to develop these techniques is underway and the initial results are presented. Fully transposed cable and braid configurations have been studied with respect to void fraction and the uniformity of void distribution. Lay and twist pitch of the cable are important factors influencing these characteristics. Full sized copper cables have been fabricated and analyzed.

34259 Large Coil Program magnetic system design study. Moses, S.D.; Johnson, N.E. (System Development Corp., Oak Ridge, TN). pp 957-961 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The primary objective of the Large Coil Program (LCP) is to demonstrate the reliable operation of large superconducting coils to provide a basis for the design principles, materials, and fabrication techniques proposed for the toroidal magnets for the THE NEXT STEP (TNS) and other future tokamak devices. This paper documents a design study of the Large Coil Test Facility (LCTF) in which the structural response of the Toroidal Field (TF) Coils and the supporting structure was evaluated under simulated reactor conditions. The LCP test facility structural system consists of six TF Coils, twelve coil-to-coil torsional restraining beams (torque rings), a central bucking post with base, and a Pulse Coil system. The NASTRAN Finite Element Structural Analysis computer Code was utilized to determine the distribution of deflections, forces, and stresses for each of the TF Coils, torque rings, and the central bucking post. Eleven load conditions were selected to represent probable test operations. Pulse Coils suspended in the bore of the test coil were energized to simulate the pulsed field environment characteristic of the TNS reactor system. The TORMAC Computer Code was utilized to develop the magnetic forces in the TF Coils for each of the eleven loading conditions examined, with or without the Pulse Coils energized. The TORMAC computer program output forces were used directly as input load conditions for the NASTRAN analyses. Results are presented which demonstrate the reliability of the LCTF under simulated reactor operating conditions.

34260 PLT toroidal field coils: operational deflection measurements. Marino, R.E. (Princeton Univ., NJ); Blaumoser, M. pp 1237-1240 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The original deflection analyses on the PLT toroidal field coils predicted values much lower than those measured. Both a new analytical solution for the deflection of laminated beams and a finite element model of the PLT toroidal field coils have yielded increased deflections by including a shear deflection in the interlaminar bonding material. Initial tests have successfully employed linear variable differential transducers (LVDT's). These devices were used to measure vertical bore deflections of the TF coils with reference to the upper and lower surfaces of the vacuum chamber. Results compare favorably with data recorded during initial TF coil power tests. LVDT devices and high resistance linear potentiometers have also been used to record a change in vertical chordal length outboard of the vacuum chamber. In this arrangement the measurement equipment is affixed to the side of a TF coil. Data from these experiments also compare favorably to initial data taken during initial TF coil testing. Linearity and repeatability of all information is excellent. A system in which every TF coil is monitored and data used for real time operational decisions is a natural outgrowth of the results obtained thus far.

34261 Experimental results on Nb_3Al multifilamentary wires. Bruzzese, R.; Ceresara, S.; Pasotti, G.; Ricci, M.V.; Sacchetti, N.; Spadoni, M. (C.N.E.N., Frascati, Italy). pp 1255-1258 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Experimental results about the superconducting properties of a nineteen filament Nb_3Al wire are reported. This wire has been fabricated by extending a technique previously developed for the construction of a single core wire. An analysis of the heat treatment conditions which give rise to good superconducting properties is presented. A critical current density (at 4.2°K and 64 kG) of the order of 1 to 1.5 x 10^5 A/cm^2 has been obtained while the critical temperature, although lower than the bulk value, reaches 15.7°K. Preliminary results concerning pinning forces are given. Bending effects and small coil results are also given.

34262 TNS superconducting ohmic-heating system. Wang, S.T.; Fuja, R.; Kim, S.H.; Kustom, R.L.; Praeg, W.F.; Thompson, K.; Turner, L.R. (Argonne National Lab., IL). pp 1288-1292 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The superconducting ohmic-heating (OH) system is the selected design for the General Atomics Co./Argonne National Laboratory TNS tokamak design studies. The key features of the OH system design are: (1) parallel coil connection, (2) better utilization of flux core by embedding support cylinder of the toroidal-field coil within the OH inner radius, (3) independent trim coils for correcting the stray fields, (4) low-loss high-current cryostable cable design and (5) OH coil cycling circuit using a reversing bridge. Detailed designs are presented.

34263 Losses and transient field effect in superconducting cables for PF and TF coils. Shen, S.S.; Schwall, R.E. (Oak Ridge National Lab., TN). pp 1293-1296 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This paper presents results of transient loss measurements on some seven-strand cable conductors. In addition to the filamentary coupling in a single composite strand, we have observed appreciable interstrand coupling in the cables filled with solder. We also have found that the interstrand coupling depends on the arrangement of the strands. Coupling loss results are analyzed in terms of a diffusion time constant associated with the coupling mechanism. Deduction of effective resistivity is also presented and discussed.

34264 Losses in a coil where the multifilamentary composite is subjected to simultaneous orthogonal and parallel induction variations. Fevrier, A.; Peninou, J.J. (Centre de Recherches, France). pp 1305-1309 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This paper presents first measurements and calculations of losses in a "special coil" where the conductor, which carries a time-dependent current, is submitted to simultaneous orthogonal and parallel induction variations. This coil comprises an inner solenoid of square cross-section around which is wound a toroidal coil. Mea-

surements were done as a function of the maximum value of the current and of its rate of variation so that the induction variations were in the [0—2 T] range and their rates of increase in the [0—2 T/s] one. Losses per cycle increase linearly with the rate of increase of the current, for high values of this rate; whereas for low values, losses show a sharp increase when this rate goes to zero. Losses have been computed through a calculation which takes into account current and induction patterns in the composite as close as possible to the actual ones. Except for the low rate range of variation of the current, computed values are close to experimental ones within 10%.

34265 Fabrication of the conductor for the Mirror Fusion Test Facility for Lawrence Livermore Laboratory. Adam, E.; Gregory, E.; Marancik, W. (Airco Central Research Lab., Murray Hill, NJ). pp 1329-1332 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Large superconducting magnets are presently being designed for controlled thermonuclear fusion, energy storage and MHD applications. Mechanical, electrical and thermal requirements of these devices have led to the design of a new generation of conductors having a higher overall current density than the "bubble chamber" type conductors without sacrificing the necessary stability. A process to manufacture a monolithic conductor having internal cooling passages is described. The internal passages are formed by coining a pattern on a high-conductivity copper strip and forming this strip around a solder coated rectangular multifilament NbTi core. After forming, the assembly is heated and compressed to firmly solder the core to the coined strip. Perforations in the strip allow liquid helium to circulate along the internal passages thereby increasing the cooled perimeter of the conductor.

POWER SUPPLIES, ENERGY STORAGE

REFER ALSO TO CITATION(S) 34279

34266 Argonne National Laboratory energy storage and transfer experimental program. Kustom, R.L.; Wehrle, R.B.; Smith, R.P.; Fuja, R.E. (Argonne National Lab., IL). pp 1056-1059 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Brief discussions are given for the inductor-convertor bridge, and the homopolar generator. Some performance requirements are described. (MOW)

34267 Two stage opening switch techniques for generation of high inductive voltages. Conte, D.; Ford, R.D.; Lupton, W.H.; Vitkovitsky, I.M. (Naval Research Lab., Washington, DC). pp 1066-1070 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The use of an opening switch or fuse as means of further reducing the rate of current interruption by the primary opening switch has been demonstrated to be practical in generating high voltage pulses in inductive storage systems. The characteristics of two-stage switching have been investigated for a variety of storage systems with either explosively actuated switches or fuses as the primary opening element and wire or foil fuses (in sand or water) as secondary pulse steepening elements. The duration of the output pulses generated in these experiments ranges from 0.25 to 10 μsec. Peak voltages (currents) associated with these pulses are 1.1 MV (3 kA) and 0.30 MV (40 kA), respectively. Electric stress levels for explosively actuated switches commutated through a fuse have reached 16 KV/cm with a recovery time of less than 60 μsec. Fuses were found to withstand the same stress level.

34268 Voltage protection scheme for MG sets used to drive inductive energy storage systems. Campen, G.L.; Easter, R.B. (Oak Ridge National Lab., TN). pp 1079-1081 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

A recent tokamak proposal at ORNL called for MG (motor-generator) sets to drive the ohmic heating (OH) coil, which was to be subjected to 20 kV immediately after coil charge-up to initiate the experiment. Since most rotating machinery is inherently low voltage, including the machines available at ORNL, a mechanism was necessary to isolate the generators from the high voltage portions of the circuit before the appearance of this voltage. It is not the expected 20 kV at the coil that causes difficulty, because the main interrupting switch handles this. The voltage induced in the armature due to di/dt and the possibility of faults are the greatest causes for concern and are responsible for the complexity of the voltage protection scheme, which must accommodate any possible combination of fault time and location. Such a protection scheme is presented in this paper.

34269 Regulating resistor and interruptor for the toroidal field system on the TEXT Tokamak development tests. Wildi, P.; Ehsani, M. (Univ. of Texas, Austin). pp 1082-1086 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Tests on two prototype electrolytic resistors-interrupters demonstrated the practicality of this approach to interrupting and regulating high DC currents of modest voltage as they occur, for instance, in the toroidal field circuit of a tokamak fed by homopolar machines. NaOH in water solution is suitable as an electrolyte in conjunction with mild steel electrodes. Suitable materials for insulation, gaskets, etc. were established and other materials which are in common engineering usage were found to be incompatible with this particular application. The relationship given in formula together with consideration of average heating per shot permits to dimension the resistors in a conservative manner and has been used for the basic design of the TEXT resistors.

34270 Small-signal theory of gyrotrons and gyroklystrons. Symons, R.S.; Jory, H.R. (Varian Associates, Inc., Palo Alto, CA). pp 1111-1115 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

Zhurakovskiy's equation of motion for electrons in a steady magnetic field and a time-varying transverse electric field have been used to derive an interaction impedance for an electron beam passing through a TE cavity with one or more one-half sinusoid axial variations of transverse electric field. In a similar fashion an expression for transconductance of a gyroklystron consisting of TE cavities separated by drift spaces has been derived. The expressions contain relativistic corrections which are important above approximately 50 kV but give results identical with those of Hirshfield et al. at lower voltages. In addition, an analytic small-signal, space-charge theory for gyroklystrons utilizing TE/sub o,n/ cavities and a hollow electron beam has been developed. It predicts exponential growth of the modulation on the beam in a drift space free of all fields other than the space-charge fields and the steady magnetic field. The beam loading, transconductance and space-charge theories have been used to predict the stability and gain of Gyrotrons and gyroklystrons for EBT. The tubes operate at 80 kV and have produced up to 250 kW at 28 GHz.

34271 Gyrotrons for high power millimeter wave generation. Jory, H.R.; Friedlander, F.; Hegji, S.J.; Shively, J.F.; Symons, R.S. (Varian Associates, Inc., Palo Alto, CA). pp 1116-1120 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The gyrotron is a new type of microwave tube capable of producing high power output at millimeter wavelengths. Oscillator results have been described in recent Soviet publications. This paper describes work in progress at Varian Associates, Inc. to develop an amplifier of the gyroklystron type to deliver 200 kW cw at 28 GHz. Considerable progress has been made with amplifier stability to the point that amplifier gains of up to 40 dB have been measured in a pulsed experimental amplifier. Current effort is concerned with improving efficiency. A pulsed oscillator is also described which produced 248 kW peak power at 28 GHz with 34 percent efficiency. A cw oscillator is under construction. Areas for future R and D are discussed. These include gyro-TWT amplifiers with increased instantaneous bandwidth (5 to 10 percent) and operation at harmonics of the cyclotron frequency to reduce the magnetic field requirements.

34272 Princeton neutral injection power supply system. Ashcroft, D.L.; Zuvers, H.E. (Princeton Univ., NJ). pp 1147-1150 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The proposed combination of power supplies to satisfy the PLT requirements is summarized. Some operational parameters of the system are described. (MOW)

34273 TFTR neutral beam power system. Deitz, A.; Murray, H.; Winje, R. (Princeton Univ., NJ). pp 1151-1155 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The TFTR NB System will be composed of four beam lines, each containing three ion sources presently being developed for TFTR by the Lawrence Berkeley Laboratories (LBL). The Neutral Beam Power System (NBPS) will provide the necessary power required to operate these Ion Sources in both an experimental or operational mode as well as test mode. This paper describes the technical as well as the administrative/management aspects involved in the development and building of this system. The NBPS will combine the aspects of HV pulse (120 kV) and long pulse width (0.5 sec) together to produce a high power system that is unique in the Electrical Engineering field.

34274 Conductor design for low-loss superconducting energy storage coils. Janocko, M.A.; Murphy, J.H.; Eckels, P.W.; Litz, D.C.; Heyne, C.J. (Westinghouse Research and Development Center, Pittsburgh). pp 1315-1321 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

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The design of low-loss conductors for rapidly pulsed magnets requires a complete understanding of how the ac losses are induced, of the effects of ac losses on the temperature profile within a superconducting winding, and of the influence of ambient conditions, such as magnetic field and temperature, on conductor performance. The design considerations involved in selecting conductor configuration and wire specifications are often very different for rapidly-cycled, pulsed-energy storage coils from what they are for other types of large superconducting magnets. Design trade-off decisions span many disciplines, and the process of developing the conductor design involves qualitative judgements of the relative importance of each decision as to its impact on the overall design. In designing a rapidly-pulsed energy storage coil, the conductor selection is based upon: (1) the method of conductor support; (2) the degree of compaction, if any; (3) the type of electrical transposition; (4) the degree of stabilization; (5) the method of cooling; (6) the behavior of the cooling system and (7) the type and quantity of electrical insulation. To illustrate the process used in designing pulsed-energy storage coils, an examination of the conductor designs for the nominally 300 kJ energy storage coil built by Westinghouse for Los Alamos Scientific Laboratory (LASL) and the 400 kJ energy storage coil presently under construction for LASL is made. The specifications of these two coils differ significantly as to rate of discharge, repetition rate and loss level, and as a result, certain aspects of the two conductor designs, particularly the strand designs, are different. These differences are explained in terms of the ac loss and ambient conditions which the conductors experience.

COOLING SYSTEMS

34275 (PNL—2477) **Limits of helium cooling in fusion reactor first walls and blankets.** Stewart, C.W.; Bampton, M.C.C.; Aase, D.T.; Sutey, A.M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-06-1830. 40p. Dep. NTIS, PC A03/MF A01.

This study explores the practical limits of helium cooling in a simple geometry unconstrained by a particular conceptual design. Specifically, the configuration was chosen to be an externally heated straight tube considering both uniform heating and heating of half the external parimeter. Both thermal hydraulic and structural limits to the heat flux have been investigated. Curves are presented to show the heat flux and tube length which simultaneously attain both a well temperature and pressure drop/pumping power limit for a range of diameters from 0.05 to 8.0 inches and pressures from 50 to 5000 psia. Tube wall stress limits on heat flux are also shown for the same range of pressure and diameter. These results should serve as an aid in planning more complex concepts as well as evaluating helium cooling in this specific configuration.

HEATING AND FUELING SYSTEMS

REFER ALSO TO CITATION(S) 34272, 34273

34276 (CEA-R—4832) **Relations between the characteristics of the emissive plasma in an electron cyclotron resonance ion source and the properties of extracted beam with expansion cup geometry.** Grando, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jul 1977. 145p. (In French). Dep. NTIS (US Sales Only), PC A07/MF A01.

The results presented are intended to specify the characteristics of the ionized medium in an electrn cyclotron resonance ion source and the conditions of ion extraction from this medium. Firstly an analytical study of the extraction region allows one to determine the effects of intitial convergence of the beam and complementary divergence due to space charge; the axial magnetic field effects are also considered. The model of source is used with an expansion cup. The plasma expansion mechanism are analysed, the anisotropy of the medium is measured and interpreted on the basis of individual motion of charged particles in the expansion cup; the magnetic field effect on the directed motion of ions is pointed out. Probe techniques allow one to locate boundaries of different neutrality regions at the level of separation between ions and electrons; results of the decrease of electron density and axial position of the plasma are compared with theoretical models based on solutions of Poisson's equation; shapes of ion emission surfaces are calculated numerically using a point spherical diode model to take account for radial variation in the ion density in the plasma.

34277 (EUR-CEA-FC—900) **Preliminary experiments on energy recovery on a neutral beam injector.** Fumelli, M. (Association Euratom-CEA sur la Fusion, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jun 1977. 29p. Dep. NTIS (US Sales Only), PC A03/MF A01.

Energy recovery tests performed on an injector of energetic neutral atoms in which the ion source is operated at the ground potential and the neutralizer is biased at the high energy potential corresponding to the desired neutral beam energy, are presented. The operation of the suppressor grid is studied in two different experiments. These tests underline the problems to be solved for an efficient recovery of the energy of the unneutralized beam fraction.

34278 (JAERI-M—6757) **Simulation code for beam trajectories in an ion source 'IONORB'.** Ohara, Y. (Japan Atomic Energy Research Inst., Tokyo). Oct 1976. 33p. (In Japanese). Dep. NTIS (US Sales Only), PC A03/MF A01.

The computer simulation code developed is for studying optimum configuration of the ion beam extraction electrodes in an ion source. It simulates ion extraction from a source plasma and acceleration through the extraction electrodes. The shape and position of the emitter are self-consistently computed so that the plasma temperature saturation current is equal to the space-charge-limited current at the emitter. Finite ion and electron temperatures and wall sheath length between the source plasma and the electrode are considered at the emitter. The extracted ions which pass through the zero equipotential surface under the grounded electrode suffer from no space-charge-expansion because of the electron cloud. The beam divergence is thus computed on the surface. The computation is possible for both the beams from an aperture and those from a slot.

34279 Protection of neutral-beam-accelerator electrodes from spark discharges. Praeg, W.F. (Argonne National Lab., IL). pp 1087-1092 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

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See CONF-771029—P2.

The high-voltage (HV) electrodes of neutral beam sources (NBS's) must be protected from occasional sparks to ground. Spark currents can be limited with special transformers and reactors which introduce time delays that are long enough to quench the spark or to disconnect the energy source. A saturated time delay transformer (STDT) connected in series with the HV power supply detects spark faults and limits the current supplied by the power supply and its capacitance to ground; it also initiates spark quenching. Nonsaturated, longitudinal reactors limit the discharge current supplied by the energy stored in the circuit capacitance of the NBS filament and arc power supplies long enough to discharge this capacitance into a resistor. The design principles of these protective circuits are presented in this paper.

34280 TTMP heating studies on Petula Tokamak. (Centre d'Etudes Nucleaires, Grenoble, France). pp 1121-1124 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

For the purpose of TTMP heating studies, a very specific vacuum vessel mainly made of Alumina and a RF structure have been installed on the Petula Tokamak. With clean wall conditions standard Tokamak discharges have been obtained on which TTMP has been successfully tested.

34281 Megawatt power for ion cyclotron heating. Lawson, J.Q.; Newman, W.G.; Sivo, A.J. (Princeton Univ., NJ). pp 1125-1128 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The heating of plasmas by waves in the ion-cyclotron frequency regime is one of the major supplementary heating methods proposed for Tokamak machines. A 55 MHz, 5 megawatt moderate bandwidth generator is being built at Princeton to test the feasibility of effectively employing such heating methods on a reactor. The generator will be constructed in modular form so that enlargement to a TFTR sized facility can be accomplished in a straightforward, economical manner. A general RF circuit description of one of the two 2.5 megawatt generators is given along with the major design considerations and problems encountered during the design phase. The power supplies and methods which will be used to control voltage variations in the 10 megawatt pulsed power source is also discussed. Crowbar protection of the power amplifier and penultimate stages is required by the system and a discussion of these units along with the other protective schemes is presented. In order to effectively heat the plasma in a PLT sized machine, the frequency of operation must be adjusted during the pulse to track any one of several optimum eigenmodes. The capability to accomplish tracking will enhance coil loading and high transfer or coupling of energy from the feed system to the plasma. A brief description of the feedback and monitoring systems is given to accomplish the selective coupling.

34282 Lower hybrid heating system for an ignition tokamak. Brooks, J.; Harkness, S.; Jung, J.; Misra, B.; Moretti, A.; Norem, J.; Stevens, H. (Argonne National Lab., IL). pp 1132-1137 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

We have attempted to design a complete Lower Hybrid Resonance Heating System (LHRH) that could be used for TFTR, TNS, EPR, or a reactor. In addition to plasma physics constraints, we have considered those imposed by neutron radiation, surface heating of waveguides, sputtering, multipactoring, vacuum systems, materials, window design, engineering, maintenance and assembly. The system uses a Lallia—Brambilla grill which is fed by a number of waveguides entering the reactor by means of a labyrinth.

TRITIUM PROCESSING, ENVIRONMENT AND SAFETY

34283 (BNL—50748) **Removal of tritium from fusion reactor blankets. Annual report, FY 1977.** Wiswall, R.; Wirsing, E. (Brookhaven National Lab., Upton, N.Y. (USA)). 1 Oct 1977. Contract EY-76-C-02-0016. 18p. Dep. NTIS, PC A02/MF A01.

The program is concerned with investigating the chemistry of those compounds and alloys of lithium which have acceptable physical and neutronic properties. In particular, information is needed on whether tritium can be removed rapidly, and how removal rates are affected by particle size, temperature, dose rate, etc.; how stable the solids are under long irradiation; and whether they are chemically compatible with the other materials that will be present in a blanket. The ultimate objective is to specify an optimum compound or alloy; to describe methods of synthesizing it and incorporating it, with or without diluents, into blanket modules; and to be able to predict its long-term behavior under operating conditions.

POWER CONVERSION SYSTEMS

34284 High thermal efficiency x-ray energy conversion scheme for advanced fusion reactors. Quimby, D.C. (Mathematical Sciences Northwest, Inc., Bellevue, WA); Taussig, R.T.; Hertzberg, A. pp 1161-1165 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This paper reports on a new radiation energy conversion scheme which appears to be capable of producing electricity from the high quality x-ray energy with efficiencies of 60 to 70 percent. This new reactor concept incorporates a novel x-ray radiation boiler and a new thermal conversion device known as an energy exchanger. The low-Z first walls of the radiation boiler are semi-transparent to x-rays, and are kept cool by incoming working fluid, which is subsequently heated to temperatures of 2000 to 3000°K in the interior of the boiler by volumetric x-ray absorption. The radiation boiler may be a compact part of the reactor shell since x-rays are readily absorbed in high-Z materials. The energy exchanger transfers the high-temperature working fluid energy to a lower temperature gas which drives a conventional turbine. The overall efficiency of the cycle is characterized by the high temperature of the working fluid. The high thermal efficiencies which appear achievable with this cycle would make an otherwise marginal advanced fusion reactor into an attractive net power producer. The operating principles, initial conceptual design, and engineering problems of the radiation boiler and thermal cycle are presented.

34285 Pulsed acceleration of exhaust plasma in a fusion-MHD power plant. Denno, K. (New Jersey Inst. of Tech., Newark). pp 1339-1342 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The external portion of the exhaust chamber for the divertor of the PRDM fusion reactor could serve as an accelerator-induction generator channel. This is accomplished by placing accelerating DC field on the inward half and AC exciting field on the outward part. The new field system also contributes to the confinement of the separatrix surface.

INERTIAL CONFINEMENT TECHNOLOGY

REFER ALSO TO CITATION(S) 33551, 33584, 33585, 33586, 33587, 33591, 33593, 34142

34286 (BNL—50744) **Liquid wall boiler and moderator (BAM) for heavy ion-pellet fusion reactors.** Powell, J.R.; Lazareth, O.; Fillo, J. (Brookhaven National Lab., Upton, N.Y. (USA)). Nov 1977. Contract EY-76-C-02-0016. 46p. Dep. NTIS, PC A03/MF A01.

Thick liquid wall blankets appear to be of great promise for heavy ion pellet fusion reactors. They avoid the severe problems of intense radiation and blast damage that would be encountered with solid blanket structures. The liquid wall material can be chosen so that its vapor pressure at the working temperature of the power cycle is well below the value at which it might interfere with the propagation of the heavy ion beam. The liquid wall can be arranged so that it does not contact any surrounding solid structure when the pellet explosion occurs, including the ends. The ends can be magnetically closed just before the pellet explosion, or a time phased flow can be used, which will leave a clear central zone into which the pellet is injected. Parametric analysis comparing three candidate liquid wall materials were carried out. The three materials were lithium, flibe, and lead (with a low concentration of disolved lithium). Lead appeared to be the best choice for the liquid wall, although any of the three should allow a practical reactor system. The parametric analyses examined the effects of pellet yield (0 to 10 GJ), pellet mass (3 g to 3 kg), liquid wall thickness (10 cm to 80 cm), vapor condensation time (0 to 10 milliseconds), degree of neutron moderation in the pellet (none to 100%), liquid wall chamber size (radius of 1.5 meters to 4 meters), Pb/Li^6 ratio (100 to 5,000), and thickness of graphite moderating zone behind the liquid wall.

34287 (IAEA—200, pp 107-140) **Recent laser-driven-implosion measurements at KMS fusion.** Mayer, F.J. (KMS Fusion, Inc., Ann Arbor Mich. (USA)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

For efficient thermonuclear burn of laser-driven implosions of deuterium-tritium (DT) many physical phenomena must be understood. Experiments are described which give information on laser-target coupling (absorptivity), electron and X-ray preheat, hydrodynamic stability, and hydrodynamic energy transfer to the fuel.

34288 (IAEA—200, pp 9-23) **REB interaction experiments with plasmas.** Nakai, S.; Imasaki, K.; Miyamoto, S.; Yamanaka, C. (Osaka Univ. (Japan)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

The interaction of focused REB with dense plasma on solid target has been investigated. The experimental results show the

existence of anomalously strong interaction which is favourable for the pellet fusion by the implosion.

34289 (IAEA—200, pp 173-184) **Super-compression and its stability of multi-structured pellet.** Niu, K. (Tokyo Inst. of Tech. (Japan)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

To compress the multi-structured pellet, an optimal time dependence of the input laser power is derived. A criterion for the Rayleigh-Taylor instability is also given for this compression method.

34290 (IAEA—200, pp 203-231) **Laser fusion research in Osaka.** Yamanaka, C.; Yokoyama, M.; Nakai, S.; Yamanaka, T.; Izawa, Y.; Sasaki, T.; Matoba, M.; Mochizuki, T.; Kitagawa, Y.; Tanaka, K. (Osaka Univ. (Japan)). 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

In the investigation of inertial confinement fusion the "Gekko Project" uses a high power glass laser and the "Lekko Project" is an E-beam CO_2 laser system. The two different types of laser give a direct comparison of experiments at different wave lengths, pulse duration and power. The research program is directed towards the understanding of the coupling of laser light and plasma, the compression of target plasma by the implosion process and the optimum design and fabrication of target pellets.

34291 (IAEA—200, pp 3-4) **Summary of electron-beam fusion experiments.** Yonas, G. 1976.

From Advisory group meeting on the technology of inertial confinement experiments; Dubna, USSR (19 Jul 1976).

In Technology of inertial confinement experiments.

34292 (LA—7166-MS) **Assessment of dynamical parasitics in the EBS.** Elliott, C.J. (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 21p. Dep. NTIS, PC A02/MF A01.

Significant improvements will accrue to the eight-beam system (EBS) by dynamical effects (shooting on the fly) depending on whether or not strong saturable absorbers are used in the system. When strong saturable absorbers are used, there is little reserve in peak gain and the gain rises slowly near extraction; thus, the static threshold is greatly improved, but the dynamical threshold is not. In this case the dynamical or conditional thresholds are at g_0 values 0.6 to 0.7 higher than static threshold. We have also determined that the method of measuring unconditionally stable values leads to values that are 0.5 to 0.3 above static threshold, giving a net improvement over measured values of 0.2 to 0.4. When saturable absorbers are not used, the dynamical threshold increments above static threshold are 1.7 to 1.4 for the four- and six-pass modes respectively. It thus appears that somewhere between 500J to 900J per beam may be put on target without saturable absorbers,. And serious consideration should be given to postponement of saturable absorber installation. When using saturable absorbers, the 1/e rise time of the parasitic oscillation pulse at extraction is from 40 ns to 60 ns in the dynamical mode; and the full width at half maximum of the pulse is 390 ns to 415 ns when extraction (or damage) does not terminate its evolution.The values quoted here are based upon a few gain curves from one beam line and may not represent what the system could ultimately achieve. In this study we arrived at a single differential equation that adequately represents more detailed TARDAM calculations. The differential equation comes from both a point amplifier model and a model with gain and absorption uniformly spread between the two ends of the cavity. Using the differential equation, simple analytical expressions or results that are easily obtained on a HP-25 hand calculator compare within a per cent of TARDAM results for excess gain.

34293 (UCRL—13796) **Laser fusion-fission reactor systems study: 4000 MW laser fusion hybrid reactor.** (Bechtel Corp., San Francisco, Calif. (USA)). Jul 1977. Contract W-7405-ENG-48. 70p. Dep. NTIS, PC A04/MF A01.

This design study is presented in terms of the following chapters: (1) reactor design, (2) laser system, (3) power plant concept, (4) environment and safety, (5) economics, and (6) design options. (MOW)

34294 (UCRL—79788) **Simple scaling model for exploding pusher targets.** Storm, E.K.; Larsen, J.T.; Nuckolls, J.H.; Ahlstrom, H.G.; Manes, K.R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Nov 1977. Contract W-7405-ENG-48. 54p. (CONF-771136—27). Dep. NTIS, PC A04/MF A01.

From Annual American Physical Society meeting; Atlanta, GA, USA (7 Nov 1977).

A simple model has been developed which when normalized by experiment or Lasnex calculations can be used to scale neutron yields for variations in laser input power and pulse length and target radius and wall thickness. The model also illucidates some of the physical processes occurring in this regime of laser fusion experiments. Within certain limitations on incident intensity and target geometry, the model scales with experiments and calculations to within a factor of two over six decades in neutron yield.

34295 (UCRL—80081) **Design studies of a laser fusion power plant.** Maniscalco, J.A.; Meier, W.R.; Monsler, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Oct 1977. Contract W-7405-ENG-48. 21p. (CONF-771056—11). Dep. NTIS, PC A02/MF A01.

From IAEA conference and workshop on fusion reactor design; Madison, WI, USA (12 Oct 1977).

The conceptual design of a laser fusion power plant has been undertaken to exploit recent developments in target design. Advanced high-gain targets which have been developed make it possible to significantly relax the laser and optical system requirements. The power plant design features a reactor concept which utilizes a thick falling region of liquid lithium to protect the first-wall from the neutrons, x-rays, and charged particles that are produced in the thermonuclear microexplosion. The lithium waterfall has also been designed to be thick enough to significantly reduce the effects of 14 MeV neutrons and cyclical stresses on the blanket structure; thereby allowing us to consider smaller blanket structures which could last the lifetime of the plant. Fusion targets producing 700 MJ of thermonuclear energy are ignited by a 2 percent efficient, 1 MJ laser system at the rate of 1.4 Hz. Schemes for protecting the final focusing optics are described which are both compatible with this reactor system, and show promise of surviving a full year in order to minimize costly downtime.

34296 (UCRL—80210) **Requirements and new materials for fusion laser systems.** Stokowski, S.E.; Weber, M.J.; Saroyan, R.A.; Hagen, W.F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1977. Contract W-7405-ENG-48. 11p. (CONF-771040—11). Dep. NTIS, PC A02/MF A01.

From Electro-Optical systems conference; Anaheim, CA, USA (25 Oct 1977).

Higher focusable power in neodymium glass fusion lasers can be obtained through the use of new materials with lower nonlinear index (n_2) and better energy storage capabilities than the presently employed silicate glass. Silicate, phosphate, fluorophosphate, and beryllium fluoride glasses are discussed in terms of fusion laser requirements, particularly those for the proposed Nova laser. Examples of the variation in spectroscopic and optical properties obtainable with compositional changes are given. Results of a system evaluation of potential laser materials show that fluorophosphate glasses have many of the desired properties for use in Nova. These glasses are now being cast in large sizes (30-cm diameter) and will be tested in prototype amplifiers in 1978.

34297 (LA—7114-TR) **High-energy, twelve-channel laser facility (DEFIN) for spherical irradiation of thermonuclear targets.** Basov, N.G.; Danilov, A.E.; Krokhin, O.N.; Kruglov, B.V.; Mikhailov, Yu.A.; Sklizkov, G.V.; Fedotov, S.I.; Fedorov, A.N. (AN SSSR, Moscow. Fizicheskij Inst.). Mar 1978. Translation by I.O. Bohachevsky of Preprint No. 74, P.N. Lebedev Physics Institute, Academy of Sciences. 29p. Dep. NTIS, PC A03/MF A01.

This paper describes a high-energy, twelve-channel laser facility (DELFIN) intended for high-temperature heating of thermonuclear targets with spherical symmetry. The facility includes a neodymium-glass laser with the ultimate radiation energy of 10 kJ, a pulse length of approximately 10^{-10} to 10^{-9} s, beam divergence of 5 x 10^{-4} radians, a vacuum chamber in which laser radiation interacts with the plasma, and a system of diagnostic instrumentation for the observation of laser beam and plasma parameters. Described are the optical scheme and construction details of the laser facility. Presented is an analysis of focusing schemes for target irradiation and described is the focusing scheme of the DELFIN facility, which is capable of attaining a high degree of spherical symmetry in irradiating targets with maximum beam intensity at the target surface of approximately 10^{15} W/cm^2. This paper examines the most important problems connected with the physical investigations of thermonuclear laser plasma and the basic diagnostic problems involved in their solution.

COMPONENT DEVELOPMENT AND MATERIALS TESTING

34298 (AI-DOE—13219) **Helium generation in fusion reactor materials. Technical progress report, April—September 1977.** (Atomics International Div., Canoga Park, Calif. (USA)). 31 Jan 1978. Contract EY-76-C-03-071-027. 41p. Dep. NTIS, PC A03/MF A01.

The near-term objectives of this program are to measure the spectrum-integrated helium generation rates and cross sections of a number of pure elements and alloys in several high-intensity neutron sources, and to develop and demonstrate neutron dosimetry proce-

dures using some of these materials. To this end, four neutron irradiation experiments have now been run: one using accelerator-produced d-Be neutrons, two using the accelerator-produced d-T reaction, and one in the neutron field of a mixed-spectrum fission reactor. All of these irradiations have incorporated a large number of helium-generation materials.

34299 (CONF-771110—11) **Surface damage of molybdenum and TZM alloy under D^+ impact.** Das, S.K.; Kaminsky, M.; Dusza, P. (Argonne National Lab., Ill. (USA)). 1977. Contract W-31-109-ENG-38. 18p. Dep. NTIS, PC A02/MF A01.

From 24. national vacuum symposium of the American Vacuum Society; Boston, MA, USA (8 Nov 1977).

The surface damage of polycrystalline molybdenum and TZM alloy under 40-, 60-, and 120-keV D^+ impact has been investigated for irradiation in both pulsed and continuous mode for total doses varying from 1.7×10^{17} to 2.2×10^{19} ions/cm^2 and for target temperatures verying from ambient temperature to 400°C. Analysis by scanning electron microscopy of the MO samples held at ambient temperatures during D^+ irradiations in both pulsed and continuous modes revealed surface damage due to blistering for the 40-keV and 60-keV irradiations for doses ranging from 8.7×10^{17} to 8.1×10^{18} ions/cm^2, but no detectable damage for the 120-keV D^+ irradiations for doses ranging from 4.3×10^{18} to 2.2×10^{19} ions/cm^2. This observed difference in the blistering behavior is attributed to the differences in the ambient target temperature for the 120-keV irradiation and both the 40- and 60-keV irradiations. For irradiations at temperatures above 300°C, no blisters could be detected for any of the three energies. For similar irradiation conditions, TZM-alloy showed a reduction in blistering as compared to molybdenum.

34300 (HEDL-TME—77-110) **HEDL magnetic fusion energy programs. Progress report, July—September 1977.** Doran, D.G. (comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1978. Contract EY-76-C-14-2170. 64p. Dep. NTIS, PC A04/MF A01.

This report describes progress in three HEDL programs supported by the U.S. Department of Energy's Division of Magnetic Fusion Energy. They are (A) Irradiation Effects Analysis, (B) Mechanical Performance of MFE Materials, and (C) Preparation and Presentation of Design Data. (A) Interatomic potentials are being developed for use in simulating displacement damage in binary alloys. A computer code is being written that derives A-A, A-B, and B-B potentials from macroscopic data on A_3B alloys of $L1_2$ symmetry. The potentials are the Moliere type at small-to-intermediate separations and fitted cubics at large separations. Helium production cross sections for isotopes of Fe, Ni, and Cr, calculated with the HAUSER*4 code, are tabulated at 15 MeV. Agreement with measurements on Al and Cu was demonstrated previously. The energy dependence of the (n,α), (n,αn), and (n,nα) cross sections in the 13 to 20 MeV range are plotted for ^{56}Fe. (B) A computer code has been developed for calculating the energy deposition by 0.5 to 25 MeV protons incidents on a cylindrical metal specimen. (C) New additions to the Nuclear Systems Materials Handbook include low cycle fatigue of Type 304 stainless steel; swelling correlation for 30% cold-worked Type 316 stainless steel; friction, wear, and self-welding of Tribaloy 700; process guidelines on cleaning and cleanliness; physical properties of stainless steels; and fatigue-crack growth behavior of Inconel 600 and 718.

34301 (IAEA—199, pp 185-192) **Investigations on sputtering and secondary ion yield from metals under bombardment of noble gases in the energy range 5 to 25 keV.** Krebs, K.H. (Humboldt-Universitaet, Berlin (German Democratic Republic). Sektion Physik). 1977.

From Advisory group meeting on atomic and molecular data for fusion; Abingdon, Oxfordshire, UK (1 Nov 1976).

In Atomic and molecular data for fusion.

Investigations on sputtering and secondary ion yield from metals under bombardment of noble gases (argon) in the energy range of 5 to 25 keV is presented. An apparatus was constructed to measure the positive secondary ion field and the sputtering yield.

34302 (ANL-Trans—1129) **Aspects of the interaction of fast particles with a solid involving the design of thermonuclear reactors.** Martynenko, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Mar 1978. Translation of IAE—2815, 1977. 14p. McElroy Co., Austin, TX.

The processes which occur in the interaction of the various types of radiation with a solid in thermonuclear reactors are enumerated. Aspects of the investigation and control of these processes are discussed.

34303 In-torus zirconium—aluminum getter pumping for beam-driven tokamaks. Bromberg, L.; Jassby, D.L. (Princeton Univ., NJ). pp 971-975 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This report describes the design of a steady-state high-throughput exhaust system for a neutral beam-driven and beam-fueled tokamak plasma with 1000 A-equiv. injected current. An array of Zr-Al getter assemblies fills the entire region below the 1.9-m diameter plasma, in the same vacuum chamber. The Zr-Al getter is bonded to 1-cm-wide copper fins brazed to stainless steel tubes cooled by high-pressure helium, which maintains the operating temperature at 300°C for a thermal power loading up to 1 MW/m^2. Six stacked tubes form a 0.48-m-tall collecting module with a capture efficiency of 70 percent for D^0. Nearly uniform pumping over the 24-module 900-m^2 collection area insures a getter saturation time of 12 hr, with a down-time of 0.5 hr required for regeneration at 700°C, obtained by flowing hot helium. The getter lifetime, which is determined by sorption of impurity atoms, is at least several months.

34304 Performance of a turbomolecular pump in a pulsed magnetic field. Bieger, W. (EURATOM-KFA, Juelich, Ger.); Dippel, K.H.; Richter, F.; Usselmann, E.; Leybold-Heraeus, F. pp 976-980 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

A turbomolecular pump was tested in magnetic fields of various strengths and directions. The most critical effect is the heating of the rotor by eddy currents and the resulting expansion of the rotor. The tested type of turbomolecular pump (Turbovac 3500 with increased gaps) can be operated in homogeneous magnetic fields perpendicular to the rotor axis up to B = 6.5√(tau/t/sub p/) mT without exceeding a rotor temperature of T/sub R/ = 100°C (t/sub p/ - pulse length, tau - repetition time). Within this limit the influence of the magnetic field on pumping speed is negligible. As regards forces acting upon the rotor, fields less than or equal to 60 mT with gradients up to 0.7 mT/cm even at temperatures up to 100°C do not cause destructive effects. The tolerable magnetic fields, of course, can be increased by shielding the pump, if compatible with experimental requirements, with a high permeability casing.

34305 Remotely operable vacuum seals. Frank, A.M. (Grumman Aerospace Corp., Bethpage, NY). pp 989-993 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The development of large, non-round, bakeable, high-vacuum, remotely-operable seals breaks down into three separate tasks. The first was to provide a system capable of remotely sealing and breaking a vacuum joint. The second was to choose between mechanical and welded joints. The third, mechanical joints having been chosen, is to resolve the problems associated with extending the state-of-the-art from round seals to large non-round seals. The factors affecting the decisions made are presented and the follow-on plan is discussed.

34306 Development of large insulator rings for the Tokamak Fusion Test Reactor. Brown, T.; Tobin, A. (Grumman Aerospace Corp., Bethpage, NY). pp 1007-1010 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

This paper discusses research and development leading to the manufacture of large ceramic insulator rings for the TFTR (TOKAMAK Fusion Test Reactor). Material applications, fabrication approach and testing activities are highlighted.

34307 Constructing the vacuum vessel for JET (Joint European Torus). Rappe, G.H. (Culham Lab., Abingdon, Eng.). pp 1015-1020 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

The functional requirements for the JET vacuum vessel are to provide the environment required to contain a plasma. To comply with mechanical stability and ultra high vacuum requirements it has been designed as an all welded fabrication. The metal structure consists of 32 rigid and wedge-shaped sectors which in turn are joined together by parallel bellows to form a torus. The toroidal vacuum vessel is being constructed as a double-walled structure

throughout with the bellows linking the rigid sectors. Much consideration has been given to the choice of materials. Stress conditions at elevated temperatures and electrical requirements indicate that the most suitable material would be an alloy with a high nickel content. The final choice was to use Inconel 625 (Nicrofer 6020) for the bellows, this material having the required electrical resistivity, and to use Inconel 600 (Nicrofer 7216) which has good fabrication and welding characteristics for the rigid sectors. For constructional purposes the vacuum vessel breaks down into three stages, the bellows assemblies, the rigid sectors and the assembly of bellows and rigid sectors to form octants, which are then assembled by welding at the flexible parting joint to form a complete torus. The bellows are manufactured by a rolling process to form the convolutions, whilst the D-shaped profile is generated by a pre-determined guidance system. The rigid sectors are fabricated by forming plates into the required contour and joining by welding into the double walled D-shape structure. This paper will outline the engineering entailed.

34308 Degassing a large LHe cryopump. Denhoy, B.S.; Batzer, T.H.; Call, W.R. (Univ. of California, Livermore). pp 1045-1048 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

A method has been developed and successfully tested, to degas a large LHe cryopump. Use of this method inhibits the normally excessive pressure rise during the degassing cycle when the degassing rate exceeds the external pumping capabilities of the system. A small appendage pump, installed close to the main cryopump, absorbs all the gas, as it is desorbed from the main cryopump, with no rise in the system pressure. The appendage pump can then be isolated from the main vacuum system and degassed at high pressure. We pumped 15 to 20 x 10^3 Torr . l of H_2 on a 1.25 m^2 panel. During the degassing cycle the system pressure never rose above 1 x 10^{-4} Torr. In large vacuum systems for future fusion machines that contain cryopump panels as well as cryogenic magnets, this method is a unique and very useful tool. It will allow the degassing of cryopumps without affecting the temperature equilibrium of cryogenic magnets.

34309 Proposed control and data acquisition system for JET. Bombi, F. (Univ. of Padua, Italy); Ciscato, D.; Congiu, S.; Noll, P.; Zimmermann, D. pp 1203-1208 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

CODAS, a computerized control and data acquisition system, will be used in the JET experiment. This paper describes the organization of the system and its subdivision in a number of subsystems, each of which is serviced by a minicomputer. The main features of the proposed multi-computer configuration are discussed and the functions of each computer are outlined. The communications system between the computers is a critical part of the design: the proposed solution, which uses two computers, is discussed and the expected performance figures are given. Some indications on how the whole experiment will be operated by means of two consoles are also given, together with an outline of the role which the CAMAC interface will play in the system.

34310 Some design aspects of computer based control systems for pulsed fusion experiments. Whittle, H.R.; Fullard, K.; Murphy, E.G.; Richardson, D. (Culham Lab., Abingdon, Eng.). pp 1223-1227 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

In the design of control systems for pulsed fusion experiments there has been some resistance to the extensive use of integrated electronic circuits because of their low level signalling and susceptibility to damage in the environment of this type of plant. However, the growing size and complexity of these experiments is forcing consideration of computer-based control systems. It is now recognized that fibre-optic links can be used for the main signalling connections; whereby it is possible to isolate vulnerable electronic units from damaging inputs. In the design of these systems it is necessary to give careful consideration to the problems of writing appropriate software and to the development of suitable equipment for interfacing between the computer and the plant components.

34311 Investigation of plasma position control and sensor requirements for tokamak EPR's. Madden, P.A. (Charles Stark Draper Lab., Inc., Cambridge, MA). pp 1241-1245 of Proceedings of the seventh symposium on engineering problems of fusion research. Vol. II. Lubell, M.S. (ed.). New York; Institute of Electrical and Electronics Engineers, Inc. (1977).

From 7. symposium on fusion research project; Knoxville, TN, USA (25 Oct 1977).

See CONF-771029—P2.

In this paper the operating cycle scenario for the ANL Tokamak Experimental Power Reactor (EPR) will be used to demonstrate plasma position and shape control requirements and, subsequently, the conceptual design of a control system described.

34312 Kakuyugoro zairyo chosa shoiinkai chosa hokokusho. (Research report of the Subcommittee on Material for Nuclear Fusion). Tokyo, Japan; Japan Society for the Promotion of Science (1976). 160p. (In Japanese).

Broad bibliographical investigation regarding the materials to be used for the construction of nuclear fusion reactors and their evaluation for the design and research are reported. The investigation was conducted by the nuclear fusion reactor material investigating subcommittee of the Japan Society for the Promotion of Science. The report is divided into eight sections, namely 1) introduction, 2) physical properties, 3) chemical properties, 4) mechanical properties, 5) productivity, 6) irradiation effects, 7) environmental effects, and 8) summary. The investigated materials are molybdenum and molybdenum-base alloys, niobium and niobium-base alloys, vanadium and vanadium-base alloys, SUS-316, Incoloy 800, Nimonic PE 16, Hastelloy X, Inconel X-750, etc. In the coexistence of Hastelloy-N with Li, the corrosion rate is very large, therefore the dynamic corrosion test under the satisfactory control of impurities is strongly desired. For the tensile and creep breaking strength at high temperature, the further precise examination is required for statistic treatment. For the evaluation of productivity, it is desirable to examine along the particulars of the concept design of CTR and environmental condition data. For obtaining the data of 14 MeV neutron irradiation, the construction of a strong neutron source or a criticality experimental apparatus may be required. The radiation effects of 14 MeV must be compared with the data of 1 or 2 MeV. The data of stainless steels of 300 series are predominantly rich, so that the stainless steels can be used for at least the research reactor. For environmental effects, the research must be made on the problems, the information and data of which are short.

GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 32880

MANAGEMENT

34313 (LA—7149-PR) E-Division semiannual report. Progress report, June 1—December 31, 1977. Kelley, P.A. (comp.). (Los Alamos Scientific Lab., N.Mex. (USA)). Mar 1978. Contract W-7405-ENG-36. 96p. Dep. NTIS, PC A05/MF A01.

The status of the programs and projects of the Electronics Division is reported for the period of June through December 1977. The presentation is divided into three sections: Research, Engineering Support, and Technical Services. Each of these sections presents the activities and accomplishments of the corresponding branch within the Division. The primary goal of the Research and Development branch is to advance technology for future applications. The primary goal of the Engineering Support branch is to apply advanced technology to laboratory and material problems. The primary goal of the Technical Services branch is to provide a technical base and support for Laboratory programs. These goals are reflected in this report. Among the subject areas included are the following: radiation detectors, temperature monitoring, electromagnetic probir.g, Josephson junction switching devices, fiber optics, high-temperature electronics, HVAC systems, microprocessors, fuel cell-powered vehicles, laser fusion.

34314 (ORAU—140) Energy-related scientists and engineers: statistical profile from the NSF national sample, 1974. Finn, M.G.; Blair, L.M.; Rall, J.E. (Oak Ridge Associated Universities, Inc., Tenn. (USA)). Mar 1978. Contract EY-76-C-05-0033. 78p. Dep. NTIS, PC A05/MF A01.

Data describing the characteristics of energy-related scientists and engineers in 1974 and 1975 are presented. Section I presents data on energy-related scientists and engineers from the 1974 National Survey of Scientists and Engineers. The tables provide descriptive characteristics of scientists and engineers from all educational levels including doctorates. A study recently conducted by Manpower Research Programs at Oak Ridge Associated Universities and published by the Department of Energy [Energy-Related Doctoral Scientists and Engineers in the United States, 1975 (DOE/IR-0033)] produced similar data for doctoral scientists and engineers from a

different survey. Section II compares data on energy-related doctoral scientists and engineers from these two surveys. 35 tables. (RWR)

MATHEMATICS AND COMPUTERS

REFER ALSO TO CITATION(S) 33645

34315 (ORNL/TM—6294) **RJESTATS: a system of programs for remote job entry station accounting.** Strand, R.H.; Raine, G.B.; Tharp, M.L.; Griffith, N.A. (Oak Ridge National Lab., Tenn. (USA)). Mar 1978. Contract W-7405-ENG-26. 18p. Dep. NTIS, PC A02/MF A01.

The RJESTATS system of programs provides accounting information on the use of the Environmental Sciences Division Remote Job Entry (RJE) facility. Summaries can be generated to display the number and kind of users, types of jobs run through the RJE facility, and the persons (or projects) that are utilizing the facility. Sample tables are presented to show certain summaries by user name, job name initials, and types of jobs run. RJESTATS is useful for managing and determining the use of an IBM-compatible RJE facility.

34316 (SAND—77-1845C, pp 576-592) **R7912 Fortran-linkable software.** Watkins, L.M. (Sandia Labs., Livermore, CA). 1977.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

In Proceedings of the digital signal processing symposium.

Software subroutines were developed for the Tektronix R7912 waveform digitizer which are RT-11 Fortran-callable and run on the PDP-11. Data collected from the digitizer are stored on a file in both raw and normalized form, and the user is informed as to the level of confidence to be expected in the normalized data. These capabilities and more are accomplished in three routines which initialize the transient digitizer for operation in the repetitive or single-sweep mode, unload raw data from the R7912 memory, and normalize raw data for signal processing or plotting. 5 figures, 2 tables.

34317 (SAND—77-1845C, pp 631-643) **High-speed lookup table technique for digital multiplication.** Simpson, J.E.; Wayne, R.A. 1977.

From Digital signal processing symposium; Albuquerque, NM, USA (6 Dec 1977).

In Proceedings of the digital signal processing symposium.

A tabular multiply method was developed to return 12 bits of product information from two 12-bit binary inputs in about two microseconds when operated at ten volts. Each converted binary input is used to address a ROM-stored pointer; the two binary pointers are added and biased as necessary to address a unique product answer. This method appears to be promising for implementation in fixed-point, real-time digital algorithms for signal processing with small computing systems requiring multiply (or divide) operations where approximations of results are satisfactory. 2 figures, 2 tables. (RWR)

34318 (SAND—78-8205) **EDITOR: a text editor for the PDP-11 (RT-11).** Tanner, D.N. (Sandia Labs., Livermore, Calif. (USA)). Mar 1978. Contract EY-76-C-04-0789. 54p. Dep. NTIS, PC A04/MF A01.

EDITOR is a program used to create and modify any text or source program. The program runs on the PDP-11 with the RT-11 operating system (V2C or V3). EDITOR is a line editor with an emphasis on text safety and ease of use. Character string search and substitution, selective input and output, line printer and terminal listing features are provided.

34319 (UCID—17705) **Advanced digital processor technology base development for Navy applications: the S-1 project.** McWilliams, T.M.; Widdoes, L.C. Jr.; Wood, L.L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1977. Contract W-7405-ENG-48. 572p. Dep. NTIS, PC A24/MF A01.

The design of a state-of-the-art, high-performance data processor is presented. A general description of the S-1 multiprocessor architecture and an overview of the organization of a specific S-1 multiprocessor configuration are given first. Then processor architecture is described in detail, including caches, virtual memory, memory access modes, status, I/O, and instruction set definition. The S-1 design system (SCALD) used to design and implement both single- and multiprocessor configuration is then discussed. Finally, the detailed design and hardware implementation of the first prototype S-1 processor are presented. 388 figures. (RWR)

34320 Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976). 1337p. (CONF-761213—). Inc., Piscataway, NJ $40.00.

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

The 1976 IEEE Conference on Decision and Control was the seventh major annual meeting of the IEEE Control Systems Society. The sessions were on aerospace applications, differential games and minimax problems, realization and estimation of bilinear and nonlinear systems, biomedical applications of pattern recognition, large systems and decentralization, optimal control theory and economic policy, transform methods for multivariable systems, applications of robotics and artificial intelligence, agricultural models, optimization in engineering design, application of estimation techniques to target tracking, two-dimensional recursive filtering, systems theory in agricultural economics, distributed and hereditary systems, correlation guidance, geometric systems theory, optimization techniques in data communications, application of modelling/simulation to public policy, use of optimal control in aircraft systems, large scale transportation, stochastic control, new perspectives in teaching, military systems, and algebraic systems theory. Individual entries were made for 16 papers.

34321 Linear regulator design for stochastic systems by a multiple time scales method. Teneketzis, D.; Sandell, N.R. Jr. (Massachusetts Inst. of Tech., Cambridge). pp 216-218 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

A hierarchically structured, suboptimal controller for a linear stochastic system composed of fast and slow subsystems is developed. It is proved that the controller is optimal in the limit as the separation of time scales of the subsystems becomes infinite.

34322 Decomposition vs. decentralization in large-scale system theory. Sandell, N.R. Jr. (Massachusetts Inst. of Tech., Cambridge). pp 1043-1046 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

Decomposition and decentralization methods in quadratic optimal control are compared. Two new decomposition algorithms are presented.

34323 Exact solution to Lyapunov's equation using algebraic methods. Djaferis, T.E.; Mitter, S.K. (Massachusetts Inst. of Tech., Cambridge). pp 1194-1200 of Proceedings of the 1976 IEEE conference on decision and control including the 15th symposium on adaptive processes. New York; Institute of Electrical and Electronics Engineers, Inc. (1976).

From IEEE conference on decision and control; Clearwater, FL, USA (1 Dec 1976).

See CONF-761213—.

Let $A'P + PA = -Q$ be a Lyapunov equation with A being a stability matrix and both A and Q, matrices with rational entries. By multiplying A and Q by a suitable positive integer an equivalent Lyapunov equation $A_1'P + PA_1 = -Q_1$ is obtained, with A_1 and Q_1 having integer entries. Let I(x,y) be the ring of polynomials in x and y over the integers I, and E be the set of all square matrices with integer entries. The solution, P, to this equation is given by P/sub u/ = (e/sub mn/) = f/sub A_1/ (q/sub u/(x,y), Q_1), $P = 1/u^2 \times$ P/sub u/, where q/sub u/(x,y) is an element of I(x,y) and u is an element of I; f/sub A_1/: I(x,y) x E → E defined as f/sub A_1/(h(x,y), M) = Σ/ sub j,k/ h/sub jk/(A_1')/sup j/ x M x A_1/sup k/, which is a finite sum. The calculation of u and q/sub u/(x,y) requires finding the characteristic polynomial of A_1, as well as using the Euclidean algorithm, computations which lead to polynomial coefficient growth. In order to eliminate the space-consuming manipulation of large integers in intermediate steps, modular arithmetic is used to obtain the matrix p/sub i/P/sub u/ = (e/sub mn/ mod p/sub i/) and p/sub i/u = u mod p/sub i/ with p/sub i/ a prime, for a sufficient number of primes. The Chinese Remainder Theorem is then applied to obtain the solution, P. The algorithm was programed on MACSYMA, which is a very suitable computer programing system for all the numerical computations involved. Numerical results as well as extensions to solving the algebraic Riccati equation are presented.

34324 (LA-tr—78-31) **Integration of differential systems which admit continuous transformation groups.** Vessiot, E. Translated from *Acta Math. (Djursholm);* No. 28, 307-350(1904). 47p. Dep. NTIS, PC A03/MF A01.

Abel has studied algebraic equations admitting known rational transformations. Lie has established the theory of differential systems which admit continuous groups of transformations. The present work defines and studies the various problems of integration to which the application of Lie's theory may lead. The first part of the treatment studies the determination of the automorphic systems which correspond to a group given by the defining equations for its

finite transformation. The second part studies the formation of the most general differential systems, which have one group given by the defining equations of its finite transformation. The process indicated provides, in a precise and elegant form, a reduction of a given system which admits the group under consideration to a resolvent system and an automorphic system. (RWR)

INFORMATION HANDLING

34325 (UCID—17746) **Document control program (DCP).** Burger, M.J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jan 1978. Contract W-7405-ENG-48. 23p. Dep. NTIS, PC A02/MF A01.

The management and control of classified and unclassified documents is tedious, time consuming, and error prone. DCP is a simple, inexpensive, but effective program for the Livermore Time Sharing System and is written in TRIX and TRIX AC. It is used to computerize the classified document control task with a completely self-contained program requiring essentially no modifications or programer support to implement or maintain. DCP provides a complete dialect to prepare interactively the input data, update the document master file, and interrogate and retrieve any information desired from the document file. 2 figures. (RWR)

CORPORATE INDEX

In the Corporate Index, report literature is indexed using the name of the organization or institution responsible for issuing the report. Headings are provided for all report literature and for published literature for which a corporate approach is especially desirable, e.g., symposium and conference proceedings.

Each entry under a corporate heading gives the report title and the volume and abstract numbers. Report numbers, if applicable, are given in parentheses at the end of the entry.

DOE Energy Information Data Base: Corporate Author Entries (TID-4585) is used in the standardization of corporate entries. TID-4585 is available for purchase from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, Virginia 22161.

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Air Force Avionics Lab., Wright-Patterson AFB, Ohio (USA)
Experimental investigation of a helium-air-methane laser. Technical report Sep 70—Mar 71, 3:33543 (AD—886909)

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processses applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed.

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